

STABLE CARBON ISOTOPES AND PREHISTORIC
DIETS IN THE EASTERN CAPE PROVINCE,
SOUTH AFRICA.

This thesis is submitted for the
fulfilment of the requirements
for the degree - Master of Arts
(Archaeology).

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PLATE I

Photograph taken between 1900 and 1910 of a cave believed to be located on the farm Wilton, Albany District: This photograph is of interest as it provides an insight into the method of excavation adopted at the beginning of this century. The person in the centre is Dr. Schonland who was director of the Albany Museum at this time. The names of the other persons in this picture are unknown.



ABSTRACT

The research reported in this thesis involves the measurement of stable carbon isotope ratios in human bone collagen as a means of reconstructing prehistoric diets. The sample population includes 67 skeletons of hunter-gatherers, pastoralists and agriculturalists from the Holocene of the Eastern Cape Province, South Africa. The aims of the thesis include the testing, through direct quantitative measurements, of the validity of archaeological conclusions about prehistoric human behaviour in the Eastern Cape. Secondly, the usefulness and applicability of the ^{13}C tracer technique is demonstrated in what is arguable the most complex situation an archaeologist is likely to encounter. The natural environment included C_3 and C_4 plants, browsing and grazing ungulates, and a marine component - all subject to environmental change over the period under study - while the cultural environment included three different subsistence systems plus transition stages between them. A third, or subsidiary goal, was to test whether burial practices can be correlated with subsistence economies in this situation - that is, whether ritual and dietary behaviour formed part of some larger cultural whole such as "pastoralists" - in order to be able to assign individuals to socio-economic groups on the basis of burial pattern. The results of the laboratory analysis realize these goals with varying degrees of success and with important consequences for the archaeologist.

DEDICATION

To those early pioneers of archaeology in the Eastern Cape who, even while apparently committing grave robbery, scientific sacrilege and assorted kinds of archaeological mayhem such as digging without proper stratigraphic controls, somehow assembled the skeletal sample for this analysis. We should all be so lucky.

PREFACE

The first time I got involved in carbon isotope studies was during my honours year in 1976. My initial program involved a detailed study on the literature surrounding this subject, and a pilot study involving the testing of carbon isotope values on humans against the archaeological interpretations provided for the South West Cape, South Africa. Upon deciding to expand the study the lack of human skeletal material in collections from the South West Cape became apparent and I had to look elsewhere. In the meantime, I worked in the Archaeometry Laboratory, University of Cape Town, where I had the opportunity to learn about the laboratory procedures involved in the processing of materials for ^{13}C analysis. In July 1977, enroute to a conference in Pietermaritzburg, I stopped off in Grahamstown. The curator of archaeology at the Albany Museum was at this time Mr. M. Cronin, who suggested that I have a look at the Albany museum human skeletal collection. The collection proved to be suitable for my requirements. For permission to analyze bone samples from the collection I thank the director of the Albany Museum; for assistance in selecting the samples and compiling associated information about the burials, I thank M. Cronin and C. Poggenpoel. In addition further skeletal samples were provided by Professor H.J. Deacon of the University of Stellenbosch, and the South African Museum - these sources are acknowledged. During the second half of 1977 the preparation of bone samples began and by March 1978 the actual combustion of samples commenced.

For the use of facilities and advice about the preparation of samples - the help of Professor N.J. van der Merwe (Dept. Archaeology, UCT), and Dr. J.C. Vogel (C.S.I.R.) is appreciated. Further help in the laboratory was given by M. Herbert and S. Rees.

All the samples processed at the Archaeometry laboratory were sent to the C.S.I.R. in Pretoria for mass spectrometric analysis, where they were processed by J.C. Vogel and E. Lursen.

A further trip to the Albany museum was undertaken to gain further information about the actual skeletons sampled - the assistance of A. Hausman, A. Morris, and the Albany museum library is appreciated.

In putting together a project such as this, several people assisted and my thanks are due to R. Maxwell (Solms van Niekerk), for the loan of a typewriter, M. Herbert and R. Maxwell for taking photographs, C. Poggenpoel for advice on drawings, and V. Main and J. Balsdon for typing. A special word of thanks is due to my mother and family for their support and finally to my supervisor Professor N.J. van der Merwe, who not only suggested this topic, but made sure I completed it.

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CHAPTER I

INTRODUCTION

This thesis uses $^{13}\text{C}/^{12}\text{C}$ ratio measurements of human collagen to determine prehistoric human diets. The sample population includes hunter-gatherers, pastoralists and perhaps some early agriculturalists of the Eastern Cape Province, South Africa. Their possible food sources include marine animals, terrestrial animals and C_3 and C_4 plants. This is considered to be the most complex situation in which the method can be applied. The results are compared with dietary conclusions reached by other archaeological techniques and serve to demonstrate the usefulness of carbon isotope measurements as a tracer technique. The following aims form the basis of this thesis:

- a) To test the validity of conclusions about prehistoric behaviour (i.e. diet, exploitation of environment, introduction of new subsistence systems) in the Eastern Cape as arrived at by archaeologists on the basis of indirect evidence (i.e. food remains, stone artefacts), and inference (i.e. changes in percentages through time). This is done by using an independent method of assessment (i.e. through the use of carbon isotope ratios), the theory of which has been worked out on plants and animals, with some applications to humans.
- b) Since this method is still in the developmental stage, especially regarding humans, a secondary and parallel goal is to show its applicability and usefulness in the most complex situation an archaeologist is likely to encounter.

- c) Subsidiary goals involve an attempt to separate different burial patterns on the basis of ^{13}C measurements and to assign the different individuals to socio-cultural groups without the benefit of physical anthropological or other cultural considerations.

CARBON ISOTOPES IN NATURE

Carbon occurs in three isotopes, one of which is radioactive while two are stable. Carbon-14, the radioactive species, forms the basis of the radiocarbon dating process and is well known to archaeologists. Carbon-12 and carbon-13, the two stable isotopes are as yet relatively unknown to archaeology - they are examined in this theses in relation to their application to archaeological research.

Early measurements of $^{13}\text{C}/^{12}\text{C}$ ratios revealed systematic differences in the ^{13}C content of various reservoirs of the global carbon cycle and, as a result, stable carbon isotopes have been used extensively as tracers in the environmental sciences. From these researches it was realised that one of the most important steps in the global carbon cycle is the photosynthetic fixation of carbon by both aquatic and terrestrial plants. Three pathways of carbon dioxide fixation occur in plants:

- a) The Calvin Cycle which is confined to C_3 plants - this pathway is the principal carbon assimilatory process found in most terrestrial and aquatic plants. Carbon isotope

studies on C_3 plants show that these plants have a mean $\delta^{13}C$ value of -26.5/mil, with respect to the average for marine limestone (PDB standard).

- b) In plants known as C_4 plants, the entry of carbon dioxide during photosyntheses is mediated via the C_4 - Dicarboxylic Acid or Hatch-Slack photosynthetic pathway. C_4 plants are confined to some tropical grasses (sugarcane, maize and millet), and show a mean $\delta^{13}C$ value of -12.5/mil, which is more positive than C_3 plants.
- c) Crassulacean Acid Metabolism (CAM) is confined to succulents growing under semi-arid conditions. These plants show isotope values covering both the C_3 and C_4 isotope range and therefore cannot be separated from the above on the basis of their isotope composition.

In marine plants and fresh water plants, the fractionation of the carbon isotopes are found to be affected by additional factors such as water temperature, pH, carbon dioxide source/concentration and the total hardness of the water. Most marine plants show similar $\delta^{13}C$ values to C_4 plants and have a mean approximating -14.0/mil, which fluctuates as the above mentioned physiological factors vary. Marine phytoplankton show similar $\delta^{13}C$ values as do C_3 plants. In fresh water habitats plants are found to have $\delta^{13}C$ values in the C_3 plant isotope range.

Thus two groups of plants can be readily separated on the basis of their ^{13}C content. C_3 plants, marine plankton, and fresh water plants have average $\delta^{13}C$ values (relative to the PDB marine limestone standard) of -26.5/mil. Marine plants and C_4 plants have average $\delta^{13}C$ values in the range of -12.0 to -14.0/mil.

The latter may be termed ^{13}C enriched plants.

^{13}C AS A DIETARY TRACER

Carbon isotope studies on animals have shown that the ^{13}C content of the whole animal and its waste products represent the isotope composition of its diet. Ungulates which consume only C_3 plants develop a C_3 isotope composition. Similarly, those which consume C_4 plants develop a C_4 isotope composition. Furthermore, ungulates consuming both C_3 and C_4 plants in varying quantities show mixed ^{13}C contents, from which it is possible to determine the percentage contribution made by C_3 and C_4 plants in the overall diet.

In most studies on animals specific fractions such as bone collagen, hair, muscle and fat are used to obtain isotope measurements. Collagen, a fibrous protein, has proved to be enriched in ^{13}C with respect to the whole animal body and its diet, while lipid fractions were found to be depleted in ^{13}C content.

The use on animal tissues thus provides a technique for the isotopic assessment of the diet of large animals or humans and can be used when only a specific body part is available. For instance, in most archaeological contexts bone is preserved and is well suited to ^{13}C analysis, provided it is not completely decayed or totally mineralised. Collagen, which represents the organic carbon fraction derived from food the animal has

consumed can be extracted from bone and subjected to isotopic analysis. The $^{13}\text{C}/^{12}\text{C}$ ratio obtained is corrected by adding an 'enrichment factor' which gives an assessment of the animal's diet. Collagen has an additional advantage over other body tissues in that it has a slow turnover rate of greater than 10 years in adults, therefore the organic carbon derived from the diet of an adult human reflects the average food carbon intake over a period of greater than 10 years, giving valuable information about long-term dietary patterns.

In archaeology isotope studies have been mainly confined to the analysis of skeletal material of North American Indians (Vogel & van der Merwe 1977; van der Merwe & Vogel 1978). Results show that the skeletal remains of hunter-gatherers who lived in a predominantly C_3 plant environment have significant isotope differences from those Indians who had subsequently cultivated and consumed maize, a C_4 plant.

APPLICATIONS TO PREHISTORIC SOUTH AFRICAN POPULATIONS

In a previous study by the author (Silberbauer 1976), isotope readings were obtained on bone collagen from prehistoric hunter-gatherers of the south west Cape Province of South Africa. The marine food intake (similar to C_4 plants in isotope composition) was considered in relation to the terrestrial foods eaten (C_3 in isotope composition). Readings on three coastal skeletons showed that up to 70% of the total organic carbon intake was of marine origin. $\delta^{13}\text{C}$ values obtained on two skeletons from the interior showed that these hunter-gatherers had a diet consisting only of terrestrial foods. These results

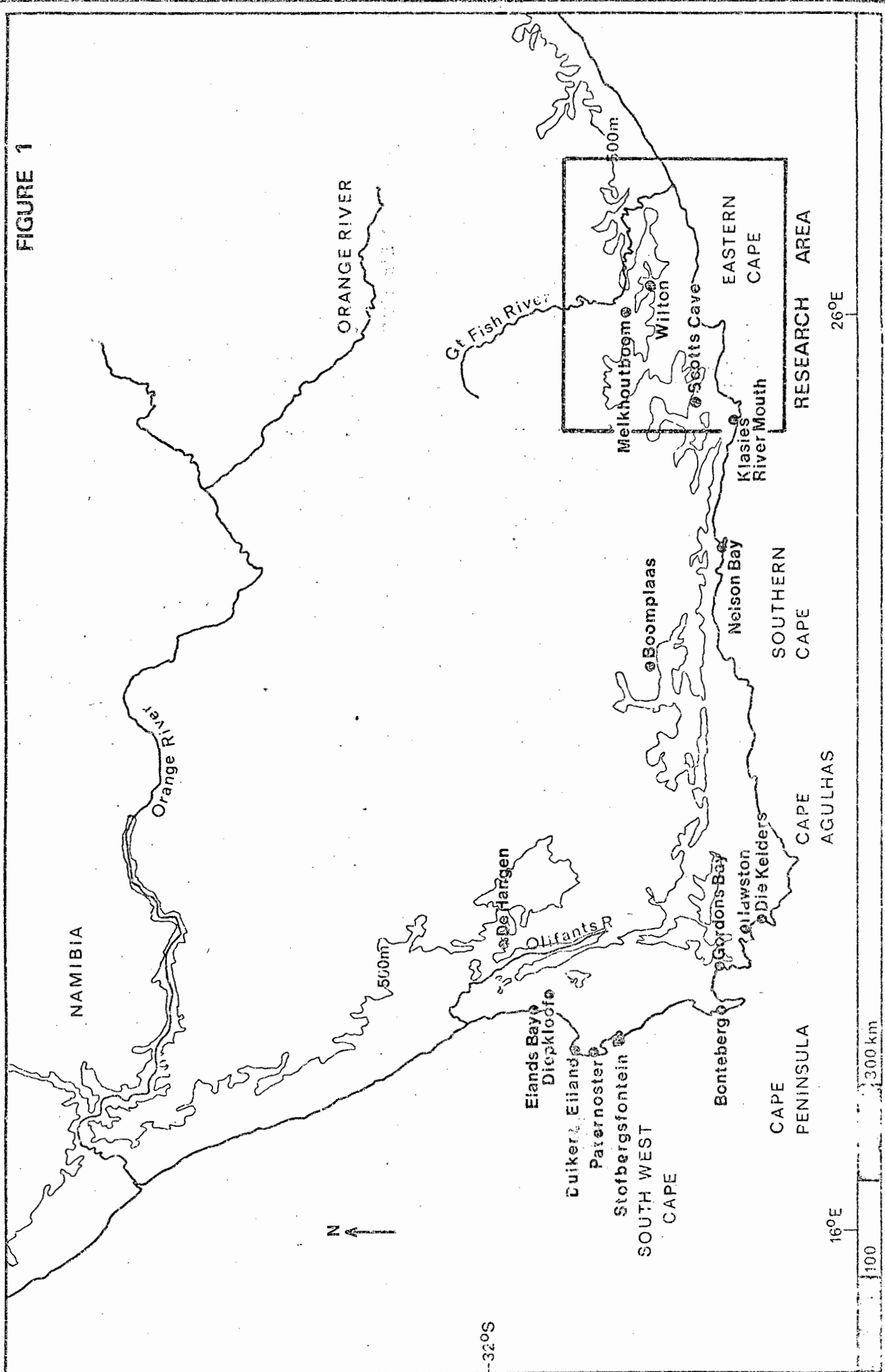
demonstrated the usefulness of carbon isotope determinations, given the correct environmental conditions, for measuring marine and terrestrial food carbon in the diet of hunter-gatherers. The results were used to test the validity of archaeological interpretations about prehistoric man's diet, resource utilization and movement.

The present study is a continuation of the investigation begun in 1976. In this study 67 individuals were sampled from the Albany Museum skeletal collection, representing a sample population from the area defined as the Eastern Cape (Figure 1). Most of the individuals sampled were excavated over the last 70 years by both amateur and professional archaeologists. In many instances the mode of burial is documented but in some cases little information is available (refer to Appendix A for detailed descriptions of each burial sampled). Of the individuals sampled, it is expected that hunter-gatherers, pastoralists and possibly agriculturalists are represented. The sample is divided into groups on the basis of burial patterns to provide a more strict cultural control over the sample analysed. With the presence of hunter-gatherers, pastoralists and possibly agriculturalists in the sample, a complex situation exists in which both C_3 , C_4 and marine foods could be involved. In addition, dependence on milk (from C_4 grazing stock) or agricultural produce such as domesticated crops (also C_4), introduces additional variables into the already complex situation which can predictably be expected for hunter-gatherer exploitation of the natural environment. This makes the study an exercise in interpreting laboratory results in the light of cultural information, as well as the reverse. The results should

FIGURE 1

Map of the Southern Cape Region, South Africa
showing major archaeological sites and the
research area.

FIGURE 1



provide some illuminating insights into the accuracy (or lack thereof) of interpretations derived from presently available archaeological research procedures.

The samples analysed were processed in the Archaeometry Laboratory at the University of Cape Town and the mass-spectrometric readings were done at the C.S.I.R. in Pretoria, by Dr. J.C. Vogel and Ms. E. Lursen.

SUMMARY OF CHAPTERS

The thesis is divided into six more chapters. Chapter II describes the environment, subsistence patterns, diet and changes observed in the archaeological, ethnological and historical records for Holocene populations of the Eastern Cape. In chapter III, the resource base of populations in this region are characterised isotopically, and the expected mean ^{13}C contents given for marine and terrestrial resources. Chapter IV combines the isotope characterisation of the resources and information known about the subsistence of Eastern Cape Holocene populations to provide hypothetical mean expected $\delta^{13}\text{C}$ values for different populations who inhabited this region. In chapter V the burial sample is grouped according to burial patterns, in order to provide a cultural grouping of the individuals analysed. Chapter VI provides information regarding the laboratory procedures used in carbon isotope analysis, and the results are given. The results are discussed and conclusions made in chapter VII. Appendix A provides individual site reports of each burial sampled for this analysis.

CHAPTER II

HOLOCENE POPULATIONS IN THE EASTERN CAPE:

DIET AND SUBSISTENCE

The research area referred to as the Eastern Cape includes the region between the mouth of the Great Fish River in the east and the Tsitsikamma coast in the west, and the hinterland as far as the Karroo Midlands (24°E to 27°E and 32°S to 34°S). This region includes physiographic features such as the coast and coastal plain, the Cape Folded Mountain belt and the southern Karroo regions (Figure 2).

In historic times (post 1500A.D.), the Eastern Cape was inhabited by Hottentots (Pastoralists), Bushmen (hunter-gatherers) and in the eastern-most region by Negro agriculturalists (Iron Age peoples). Although historical records do not refer directly to the existence of Bushmen in this region (Hewitt 1920; J. Deacon 1969), archaeological evidence shows that it was inhabited by groups of people who subsisted by means of hunting and gathering during the greater part of the Holocene (H.J. Deacon 1976). In this study the primary division between groups or populations is made on the basis of subsistence and material culture as presented in the historical, archaeological and ethnological record. Groups known to have existed by hunting and gathering are termed Hunter-gatherers, those who had domestic stock but did not grow crops are termed Pastoralists, and those who both grew crops and kept domestic animals are termed Agriculturalists.

Several important observations have been made on the subsistence,

FIGURE 2

Map of the Eastern Cape Region showing relief, rivers, towns, burial sites and other archaeological sites.

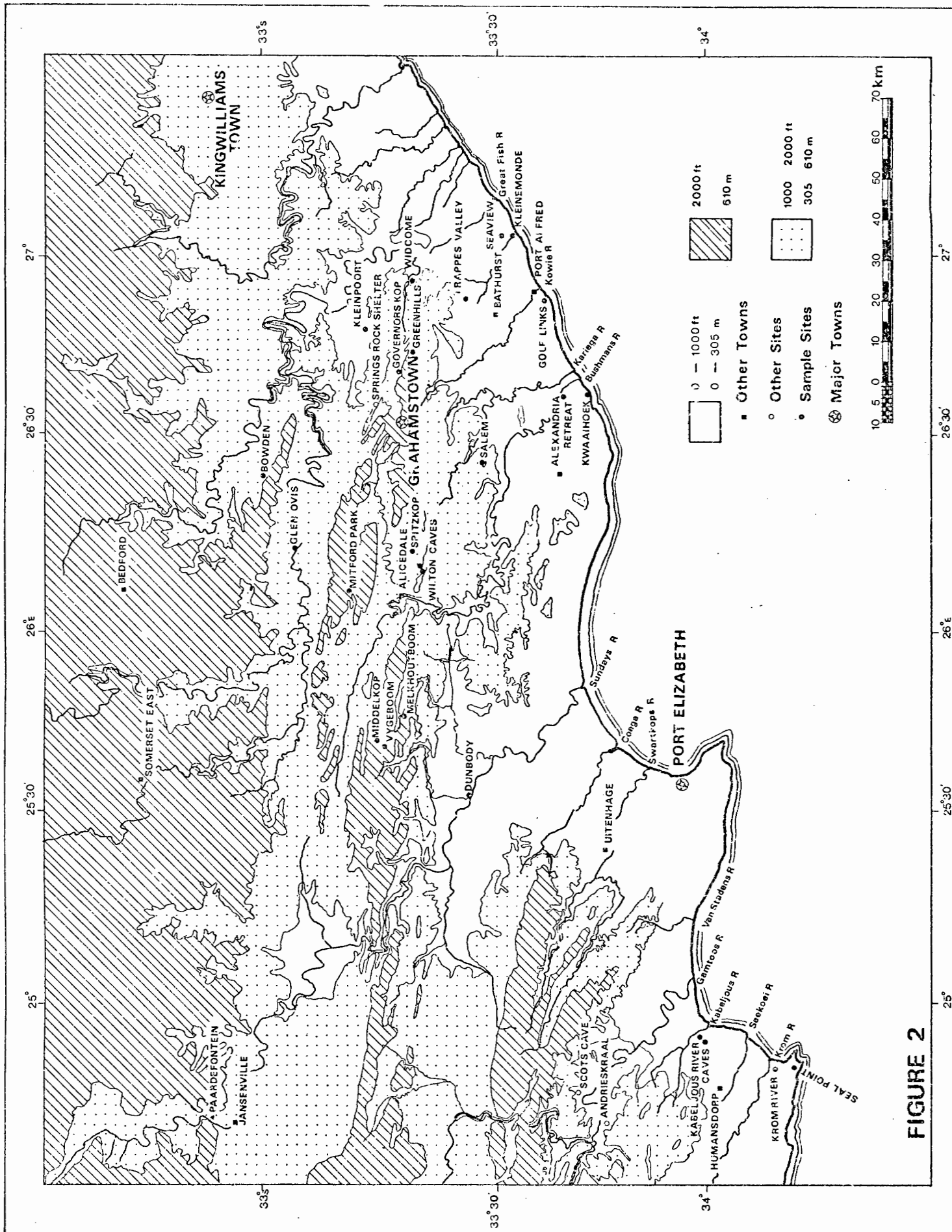


FIGURE 2

diet and stone tool technology of Holocene populations in the Eastern Cape. Early archaeological research included the excavation of several rock-shelters in this region in an attempt to establish a culture-stratigraphic sequence based primarily on lithic assemblages (Hewitt 1921, 1925, 1931, 1932). Recent research involved the re-excavation and examination of Wilton Large Rock-shelter, resulting in a chronologically ordered sequence based on stone artefacts for this site (J. Deacon 1969, 1972).

Further excavation at Melkhoutboom cave (H.J. Deacon 1969, 1976) substantiated the Wilton cultural sequence; it also provided information about diet, subsistence and population demography of hunter-gatherer populations who occupied these Eastern Cape sites during the Holocene.

This sequence is summarized in the rest of the chapter with emphasis on the diet and subsistence of Holocene populations of the Eastern Cape Region.

HOLOCENE ENVIRONMENTS IN THE EASTERN CAPE

The area defined as the Eastern Cape can be divided into four physiographic regions - the coastal plain, the folded mountain belt and the southern Karoo (Figure 2).

The Coastal region is characterised by long sandy stretches of beach interrupted by rock outcrops and river mouths. Inland from the coast a dune barrier is found to be almost continuous

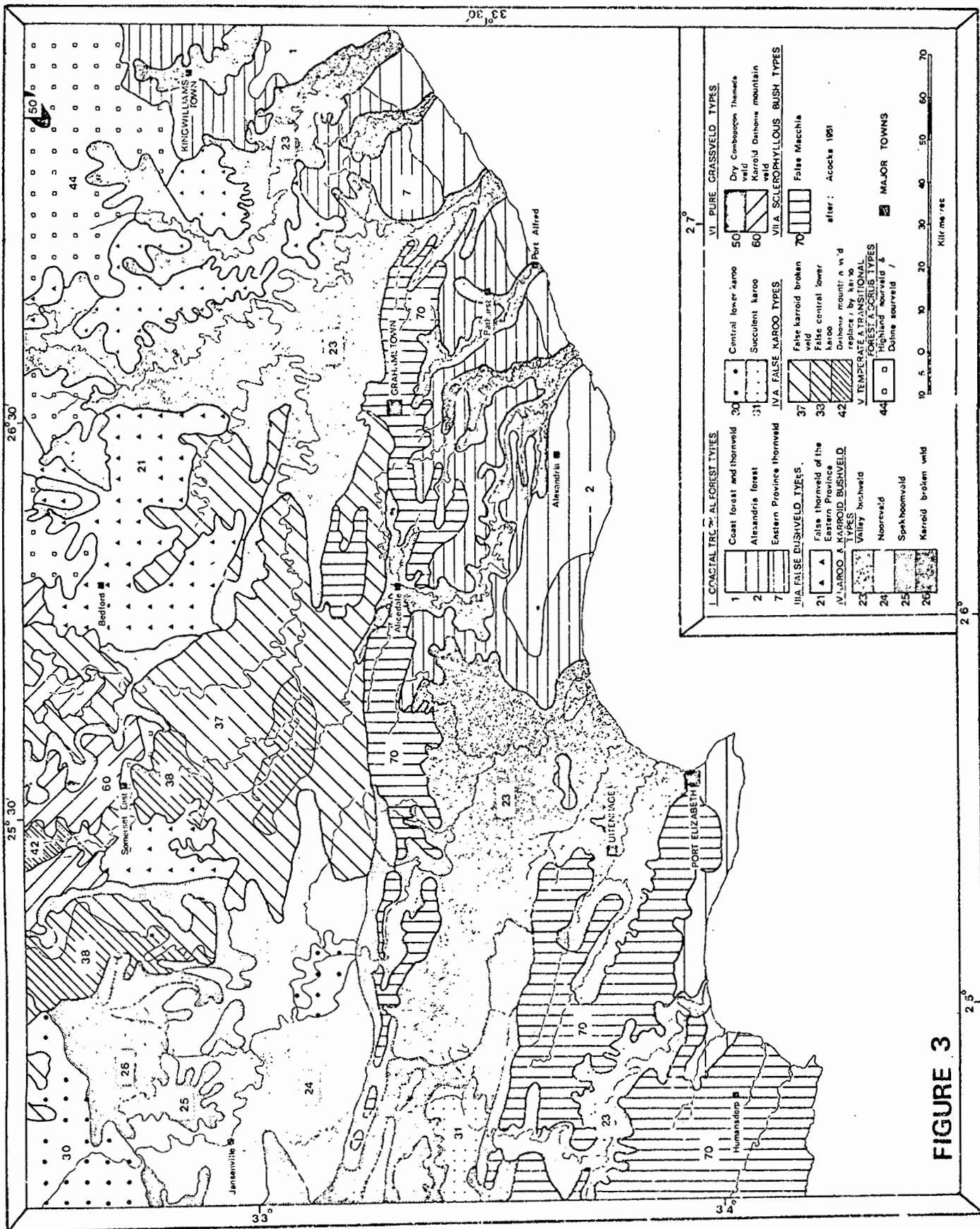
along the coast. This region is one of high productivity, in particular at rocky outcrops and estuaries. The wide variety of marine life found here falls within the group South Coast Biota, which extends from the Transkei to Cape Agulhas. It contains a few tropical species, many warm water endemics and some cosmopolitan forms (Day 1969:1). Sea temperatures on the whole are warm and fluctuate from approximately 14° to 22°C over the annual cycle. Open station shell middens are common along the coast and include food remains such as shellfish, fish, crustacea, marine mammals and birds.

The Coastal Plain is characterised by a sloping plain, dissected by river valleys rising inland from the coast to elevations up to 300 metres. The width of the coastal plain varies from 30 to 40 km. Several major rivers cut through the plain : the Great Fish, Bushmans, Sundays and Gamtoos Rivers (Figure 2). The vegetation of this region is varied and includes two Coastal Forest types, a Karroid Bushveld and a Sclerophyllous Bush type (Acocks 1975) (Figure 3). Studies of the historical records show that in the recent past the area between Uitenhage and Paterson, which includes the flat, wide Sundays river valley, supported large herds of grazing ungulates (Skead 1958). Today relict herds of buffalo and elephant are found in the Addo Elephant National Park near Addo.

The Cape Folded Mountain Belt forms a natural barrier between the coast, coastal plain and the inland Karoo regions. In the region under study, only the eastern-most extension of the Cape Folded Mountain system is present. The highest point of this range is the Zuurberg, which rises above 1,000 metres, and is

FIGURE 3

Map of the Eastern Cape Region showing
major vegetation types (After: Acocks (1975)).



dissected by mountain valleys of rivers such as the Sundays, Bushman and Great Fish Rivers. Relief and aspect have considerable influence on the vegetation forms found in this region. Rainfall is varied and ranges from approximately 500 to 800 mm per annum on the south-facing slopes, to 200 to 500 mm on the north-facing slopes. The vegetation found in the river valleys is of the Valley Bushveld type, while on the higher ground False Macchia (False Fynbos) is present (Acocks 1975). The False Macchia is believed to be an invasive vegetation, but Martin (1966) argues that these patches of Macchia are important nuclei for the spread of climax heath species and are not intrusive. It is suggested therefore that this vegetation type has evolved over a long period of time through consistent veld burns. The grass element is low, although as one moves eastwards the grass element increases. The False Macchia supports a large geophyte element, which is found to be an important aspect of prehistoric hunter-gatherer diet. Animals found in this region include bushpig, bushbuck, grysbuck and duiker. Large herds of buffalo were known to occur in the vicinity of Grahamstown in the recent past (Klein 1974).

Archaeological sites are common in this region, especially rock-shelters and cave sites. Melkhoutboom, Vygeboom, Wilton Large Rock-shelter, Spitzkop and Uniondale are some of the more important sites.

The Southern Karoo regions lie inland from the Cape Folded range and are consequently within their rain shadow. Rainfall is low and droughts are common. Botanical evidence suggests that the climax vegetation of this region has radically altered due to

bad farming practices. What was previously a climax grassveld is being invaded by False Karroid Veld (Figure 3). Valley Bushveld is found in the major river valleys such as the Great Fish.

The reduction in good grazing and excessive hunting has led to radical changes in the indigenous fauna of this area. Skead (1958:20) has shown that out of a total of 78 historically recorded species in the district of Cradock, between 13 and 17 forms are now extinct. In historic times this region supported large herds of grazing ungulates. Small antelope such as steenbuck, duiker, vaal rhebuck and mountain rhebuck are still found today. It is suggested that the fauna of this region was in the past linked with the interior rather than the Cape Folded Mountain Belt and Coastal regions (H.J. Deacon 1976).

Evidence for environmental change in the Eastern Cape region is most noticeable from historical studies on the vegetation (Acocks 1975) and the indigenous fauna (Skead 1958). These are seen as resulting primarily from man's activities.

Further change in the environment is documented for the late Pleistocene/Holocene transition; the late Pleistocene environments contrasted with the Holocene in being more open and having a more prominent grass element in the mountain zone (H.J. Deacon 1976). In contrast, the Holocene marked the inception of present day environmental conditions, although lower perturbations in climate have caused change in particular habitats. Butzer and Helgren (1972) propose that a period of temporary forest advance occurred approximately 7,000 years B.P. After this period the coastal

vegetation was more open and slopes unstable. Mesic conditions are dated to approximately 4,000 to 1000 years B.P. with a period of aridification thereafter.

H.J. Deacon (1976:19) argues, however, that the resolution of these paleo-environmental studies are too low and too generalised to provide an effective basis for predicting the environment of past Holocene populations in the Eastern Cape and elsewhere.

TERMINAL PLEISTOCENE HUNTER-GATHERERS

(10,500 TO 7800 YEARS B.P.)

Evidence of terminal Pleistocene or early Holocene populations is found in several of the larger cave sites in the Cape Folded Mountain region of the Eastern Cape. These include Melkhoutboom cave (Hewitt 1931; H.J. Deacon 1969, 1976); Wilton Large Rock-shelter (Hewitt 1921; J. Deacon 1969, 1972); and Vygeboom and Uniondale (Hewitt 1932).

Hewitt (1932:726) describes the stone artefacts from the lower levels of Melkhoutboom, consisting of large scrapers, and large quartzite and sandstone flakes. At Wilton Large Rock-shelter, J. Deacon (1969, 1972) found a similar industry in the lowest levels, dominated by large scrapers and a few other formal tools which are found in the overlying Wilton levels. This pre-Wilton industry is known as the Albany Industry (J. Deacon 1977).

From Melkhoutboom cave, remains of Equus quagga (quagga), Hippotragus leucophaeus (blue antelope), Damaliscus dorcas (blesbok/bontebok), Connochaites gnou (black wildebeest),

Alcelaphus caama (red haartebeest) and Raphicerus sp.

(grysbuck/steenbuck), are the most common ungulates represented in the Albany levels (Table I). Although browsing antelope such as grysbuck and steenbuck are represented, the medium to large grazers appear to have been the principal species hunted. A similar situation was found in early Holocene levels at Nelson Bay Cave and Klasies River Mouth on the south-east Cape coast (Figure 4) (Klein 1976), and at Boomplaas Cave in the southern Cape Folded Mountain Belt (Klein 1978), where medium to large grazers predominated. Plant food remains are not well represented at cave sites in the Albany levels. The lack of evidence relating to plant utilization in general is seen as a result of poor preservation in these levels. It has been suggested, however, that plant foods did form a part of the diet but were subsidiary to hunting (H.J. Deacon 1976:119). The presence of marine shell in levels of this period at inland sites such as Melkhoutboom, Boomplaas and Wilton Large Rock-shelter (H.J. Deacon 1976; J. Deacon 1969) and in coastal middens at Matjies River cave and Nelson Bay Cave (H.J. Deacon 1972; Klein 1974) suggests that both the coastal and inland sites fell within the territorial range of these early Holocene populations.

From this evidence, it is assumed that during the terminal Pleistocene the Eastern Cape was inhabited by hunter-gatherers who hunted primarily grazing antelope and consumed plant and marine foods. The hunting of migratory grazing antelope suggests that these populations were mobile and dispersed and as a result less territorial in relation to subsequent populations. It is also possible that a regular pattern of transhumance (on a seasonal basis) linked the sites in the Cape Folded Mountains and those at the coast (H.J. Deacon 1976:119).

FIGURE 4

Percentage frequency curves for browsers and mixed feeders identified from the Wilton and Albany levels at major archaeological sites in the Eastern Cape (Data from: Table I).

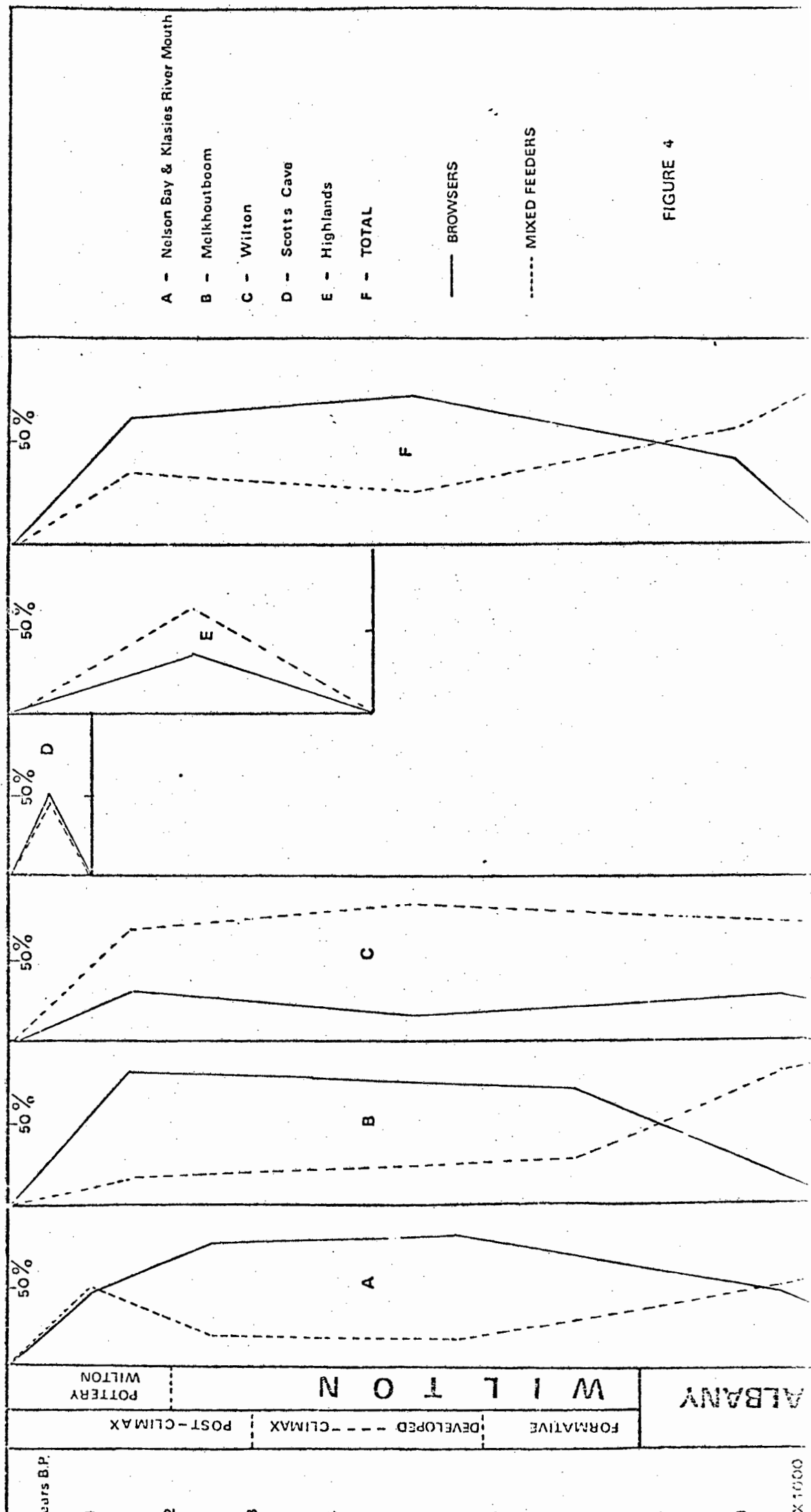


FIGURE 4

At approximately 7500 years B.P. changes occur in the subsistence base and technology of Eastern Cape hunter-gatherers, as seen particularly at Melkhoutboom Cave and Wilton Large Rock-shelter.

WILTON HUNTER-GATHERERS

(10,500 TO 7800 YEARS B.P.)

The appearance of microlithic Wilton toolkits at ca 7500 B.P. in the Eastern Cape is correlated with greater reliance on plant foods and the hunting of small browsing antelope. These include cave sites (Figure 2) such as Wilton Large Rock-shelter (the Wilton type site) (Hewitt 1921; J. Deacon 1969, 1972); Wilton Cave and Spitzkop (Hewitt 1921); the Kabeljauws River Caves (Hewitt 1925); Melkhoutboom (Hewitt 1931; H.J. Deacon 1976); and Vygeboom and Uniondale (Hewitt 1932).

The Wilton artefact tradition is characterised by microlithic tools such as scraper segments and backed tools (J. Deacon 1969). The Wilton occupation levels provide evidence of a subsistence pattern heavily reliant on plant foods, especially the geophytes Watsonia sp., Hypoxis sp., and Moraea sp. Meat was subsidiary in the diet, obtained by hunting of small antelope such as Raphicerus sp (Grysbuck/Steenbuck) Cephalus sp. (Duiker), and Tragelaphus scriptus (Bushbuck) (Table I) (H.J. Deacon 1976:120). These antelope are solitary, nocturnal browsers, in distinct contrast to the large, grazing herd animals encountered in the earlier period. From the presence of marine shells in inland caves and the presence within the same time range of sites on the coast it is evident that marine foods formed part of the diet.

It is believed that visits were made to the coast when inland resources such as plant foods were scarce. Evidence for seasonal visits to coastal sites vary for different parts of the Cape coast. Parkington (1976) concludes that Elands Bay Cave on the southwest coast was occupied for about two months of the winter, while Avery (1972) finds evidence for short summer visits in shell middens on the south coast. These conclusions were based on faunal remains. Shackelton (1973), using $^{18}\text{O}/^{16}\text{O}$ ratios in shells, suggests that Nelson Bay Cave on the South Coast was occupied during winter. Evidence of seasonal occupation of the Eastern Cape coast is lacking, but once again there has been the suggestion that occupation took place for short periods when there was a paucity of inland plants during the winter months (H. Deacon 1976).

The levels corresponding to the post-climax phase of the Wilton at approximately 3000 years B.P. (J. Deacon 1972) show that the fresh water mussel Cafferia caffer replaced the marine bivalve Donax sp. as the dominant shell species. A similar trend is seen at Melkhoutboom Cave (H.J. Deacon 1976). Hewitt (1932) also noted this increase in fresh water mussel in Upper Wilton Large Rock-shelter and at Melkhoutboom cave an estuarine shell (Nassa sp.) once again appeared after being absent through the formative and climax Wilton phases (Table II). At the Wilton name site, the replacement of Cafferia sp. in the deposits is accompanied by the increased occurrence of shale as a raw material. This has been attributed to the shift away from marine resources in favour of the utilization of inland resources (J. Deacon 1972:35). The disappearance of Donax may also have been a cultural phenomenon. Not only was Donax a source of food

but it was used in the making of shell crescents (Goodwin 1938). When the valves of Donax are retouched to form sharp edges they can be used as scrapers, examples of which were found at Die Kelders Cave (Schweitzer 1970, 1975). Avery (1977) observed Donax scrapers in shell middens along the Eastern Cape coast and Parkington (1976) found similar scrapers at Elands Bay Cave. These observations suggest that the disappearance of Donax during post-climax Wilton could be linked to observed changes in the technology (i.e. a greater variation in scraper manufacture, a lower artifact density, and a reduction in the variety of tools). The high frequency of Donax in preceding layers are thus a possible indication of its importance both as an artefact type and a cultural object. The sharp increase of Cafferia sp. after 3000 years B.P. may reflect the increased importance of the exploitation of shellfish resources generally. Klein (1974:276) observes similar changes among stone artefacts in the post-climax phase of the Wilton at Nelsons Bay Cave and at Eastern Cape inland sites, together with an increase in the frequency of fish remains. He suggests that these changes reflect a greater concentration on marine resources.

Other changes occurring at inland sites from 3000 to 2000 years B.P. include the appearance of storage pits at both Melkhoutboom Cave and Boomplaas Caves (H.J. Deacon 1976; Deacon et al 1976).

To summarize from about 7500 years B.P. to 3000 B.P.: the Eastern Cape region was occupied by populations who were primarily gatherers of plant foods and hunters of small, territorial, browsing antelope. Annual visits to coastal regions for the collection of marine foods are also evident. As a consequence

of their subsistence ecology, it has been suggested (H.J. Deacon 1976:163) that Wilton populations were organised into small foraging groups with higher overall population densities and smaller, restricted territorial ranges than the terminal Pleistocene-early Holocene populations which preceded them. Changes in diet are evident during the post-climax Wilton (3000-2000 B.P.) with the utilization of Cafferia caffer as a food source, coupled with a possible increase in the exploitation of marine foods.

THE LAST 2000 YEARS

Pottery appeared in the southern Cape region about 1,900 to 1,800 years ago. Wilton assemblages of this period are characterised by the rarity of formal tools and the breakdown of the norms of artefact manufacture common to the Wilton industry. In the Eastern Cape the earliest documented date for the introduction of sheep is approximately 1200 years B.P. (H.J. Deacon 1967). Domesticated sheep and cattle also appeared at about this time (Klein & Scott 1974). A new plant food, Cyperus usitatus, is documented for this period at Melkhoutboom and Scotts Cave in the Cape Folded mountain belt and at Highlands Rock-shelter and Tafelberg Hall in the Karoo Midlands (H.J. Deacon 1976:153). Fresh water mussel (Cafferia caffer) is abundant in pottery levels of cave deposits and fresh water mussel middens are associated with the pottery dated to this time (Stapleton 1919; Hewitt 1920, 1921).

The mammalian fauna found in Pottery Wilton levels show little

change in species composition compared to Wilton levels, although the minimum number of individuals represented is low (Klein 1974). Species such as Raphicerus (grysbok/steenbok) and Tragelaphus scriptus (bushbuck) are still the dominant ungulates represented. Plant foods are dominated by the geophytes, Watsonia sp, Hypoxis sp, and Moraea sp. Domesticated sheep appear in small numbers at sites such as Scotts Cave (Deacon & Deacon 1963). A shift to a full pastoralist economy is evident at such sites as Die Kelders and Boomplaas caves (Schweitzer 1975; H.J. Deacon et al 1978). It is evident that the traditional hunter-gatherer way of life was also replaced by pastoralism in the Eastern Cape since no hunter-gatherers were observed there in the late 1700s by European travellers (Hewitt 1920; J. Deacon 1969).

During the Pottery Wilton a shift in settlement pattern is evident, with increased occupation of small rock shelters such as Scotts Cave and Springs Rock-shelter. Long-sequence sites, such as Melkhoutboom cave, appear to have a restricted occupation during this period (H.J. Deacon 1976:54). Although there is evidence of change in subsistence and settlement pattern with the introduction of pastoralism, it is noted in the archaeological record that hunting and gathering of both marine and terrestrial foods persisted as an integral part of pastoralist economy. Schapera (1930:235) describes early Cape pastoralist groups which derived their food from cattle, sheep and goats; from game which they hunted; and from small animals and plants which they gathered in the veld. Milk from domestic stock was a principal food source, while the hunting of game and the collection of plants were important supplements. In coastal regions marine food formed another important dietary supplement. Historical records state

that the Eastern Cape was occupied by three pastoralist groups: The Damasonqua in the West, and the Hoengeiquas and Gonaquas in the East (Hewitt 1920). Most of these pastoralist groups occupied the coastal plain and inland regions from the Cape Folded mountain belt along major rivers such as the Great Fish River. Contact between pastoralists and agriculturalists in the East is recorded as early as 1600 A.D. (J. Deacon 1969:14). This contact led to the adoption and cultivation of domestic crops by pastoralists. Hewitt (1920) notes that the Swedish explorer, Spaarman, in 1722 met a group of herders who were cultivating fields of 'Caffer Corn' (sorghum), or Sorghum bicolour.

It is evident that the traditional hunter-gatherer's economy was disrupted in the Eastern Cape during the last 2000 years, so that by historical times it had been replaced by pastoralism. The process of replacement probably coincided with a period of conflict and assimilation between hunter-gatherer and pastoralist. Concomitant changes in diet also occurred among pastoralists and agriculturalists.

CHAPTER III

STABLE CARBON ISOTOPES IN NATURE

Early measurements of $^{13}\text{C}/^{12}\text{C}$ ratios revealed systematic differences in the ^{13}C content of various reservoirs of the global carbon cycle (Nier & Gulbransen 1939; Rankama 1947; Urey 1947). As a consequence of these early researches, stable carbon isotopes have been extensively used as tracers in geochemistry in related fields. Craig (1953, 1957) provided the first comprehensive summary of carbon isotope variations in different carbon compounds in nature. He concluded that one of the most important steps in the global carbon cycle - contributing both directly and indirectly to isotopic variations in carbon-based materials in nature - is the photosynthetic fixation of carbon by aquatic and terrestrial plants.

Further research on the photosynthetic processes of terrestrial plants showed that three pathways of carbon dioxide fixation occur.

- (a) The Calvin cycle or the Reductive Diphosphate cycle is confined to C_3 plants and is the principal carbon assimilatory process found in most terrestrial and aquatic plants.
- (b) In some tropical grasses (e.g. sorghum, maize and sugarcane), and certain plants from the families CYPERACEAE, AMARANTHACEAE, PORTULACEAE and CHENOPODIACEAE, the entry of carbon dioxide during photosynthesis is mediated via the C_4 - Dicarboxylic Acid or Hatch-Slack Photosynthetic pathway. These plants are termed C_4 plants (Kortshack et al 1965; Hatch et al 1967; Hatch & Slack 1970).

(c) Crassulacean Acid Metabolism (CAM), is confined to nonhalophytic plants growing under semi-arid conditions (Devlin & Barker 1967). These plants include all CRASSULACEAE and many BROMELIACEAE.

Stable carbon isotope studies reveal that both terrestrial and aquatic plants are depleted in ^{13}C with respect to the average for marine limestone (PDB standard) (Wickman 1952; Baertchi 1953; Craig 1953; Park & Epstein 1960; Abelson & Höering 1961). Terrestrial plants can be divided into two groups on the basis of their $^{13}\text{C}/^{12}\text{C}$ ratios (Smith & Epstein 1971). These two groups correlate with the C_4 and C_3 pathways of photosynthesis; C_4 plants are found to have higher ^{13}C contents than C_3 plants. The mean $\delta^{13}\text{C}$ value for C_4 plants is -12.5/mil and for C_3 plants it is -26.5/mil (Troughton 1971). CAM plants have $^{13}\text{C}/^{12}\text{C}$ ratios covering both the C_3 and C_4 plant isotope range, with a mean $\delta^{13}\text{C}$ value of -16.6/mil; they cannot therefore be separated from C_3 and C_4 plants on the basis of isotope composition (Vogel & Erhalt 1963; Neales et al 1968) (Figure 5, Table III).

In marine plants, unlike terrestrial plants, fractionation of the carbon isotopes is not only caused by internal metabolic reactions; additional factors such as water temperature, pH and carbon dioxide concentration play an important role in the determination of their ^{13}C content (Sackett et al 1965; Degens et al 1968a, 1968b). Most marine plants resemble C_4 plants in isotopic composition, while phytoplankton resemble C_3 plants isotopically. (Figure 6; Table IV). Fresh water plants are also affected by physiological factors such as pH, water state and carbon dioxide source (Broecker & Walton 1959;

FIGURE 5

Modified Dice-Leraas diagram for the ^{13}C content of terrestrial plants. The horizontal lines show the observed ranges; rectangles mark the standard deviation; with the shaded areas indicating the standard error; the vertical line indicates the mean. The broken vertical lines give the averages calculated by Vogel et al (1978) and Vogel & Erhalt (1963), for the respective plant groups.

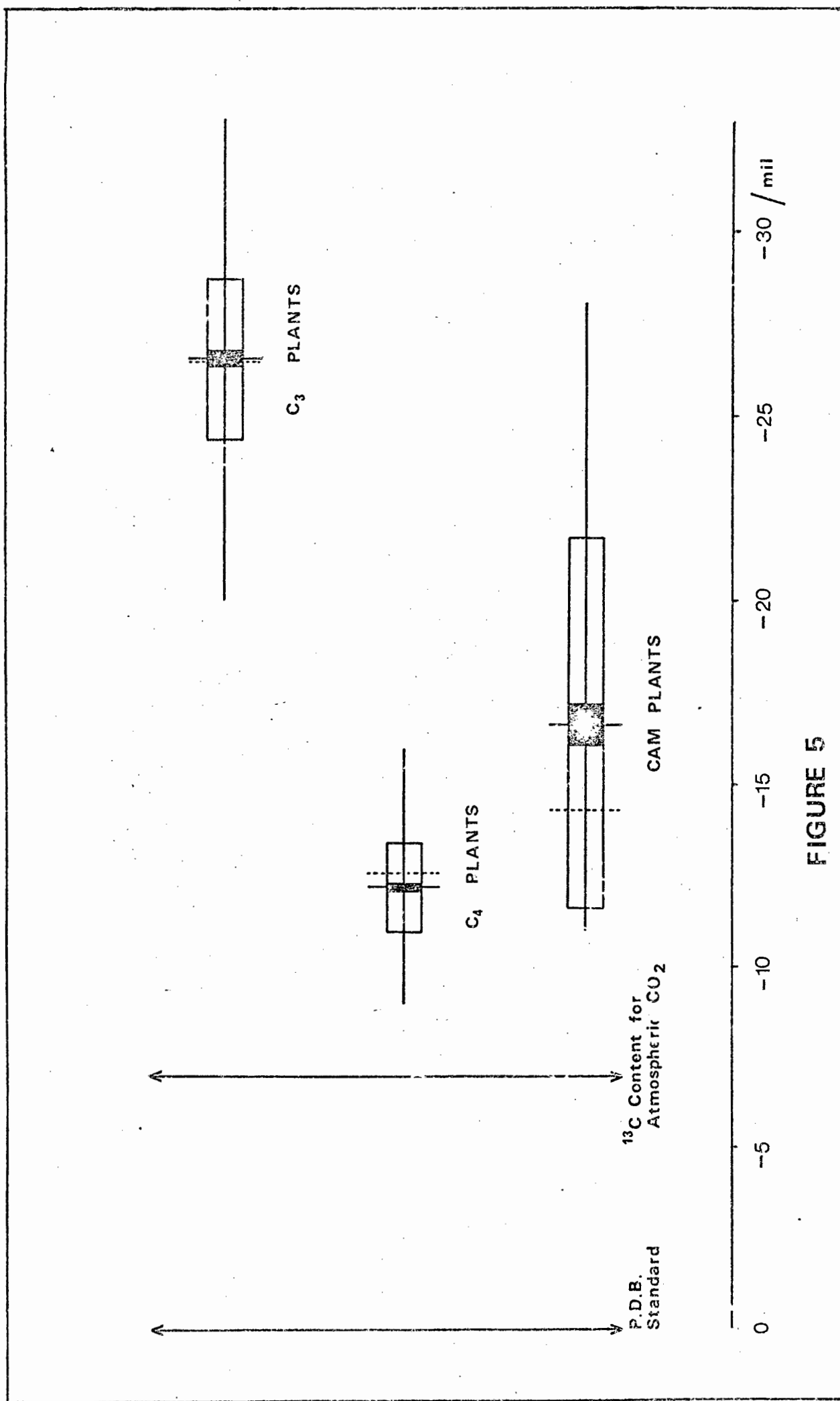
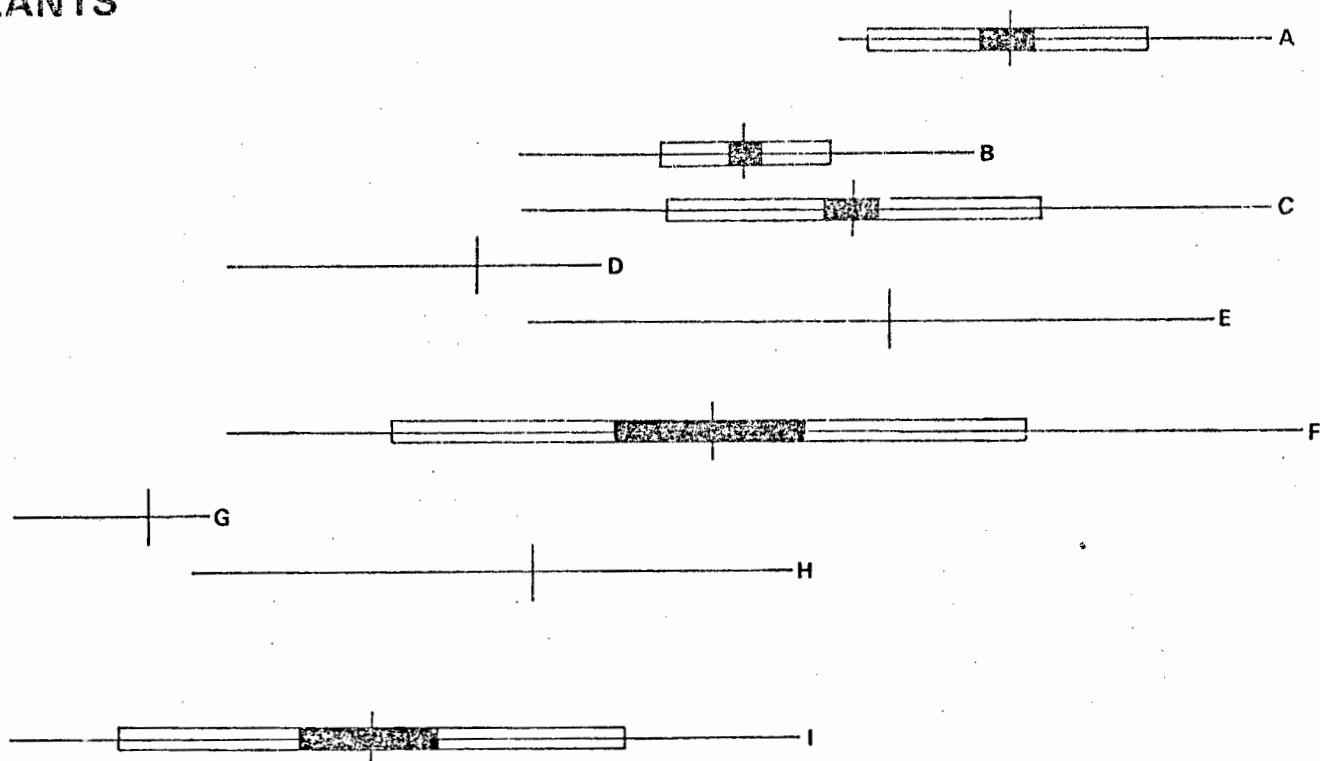


FIGURE 5

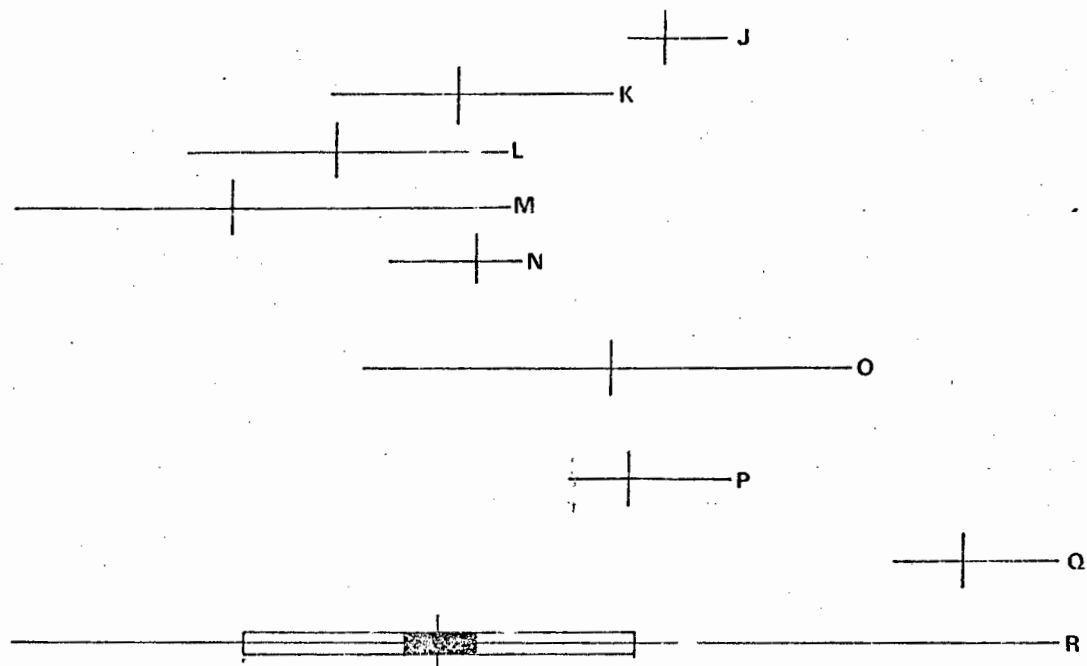
FIGURE 6

Modified Dice-Leraas diagram for the ^{13}C content of marine plants and animals from different water temperatures. The horizontal lines show the observed ranges; rectangles mark the standard deviation with the shaded areas indicating the standard error; the vertical lines indicate the mean (Data from: Tables IV; V & VI).

PLANTS



FAUNA



-10 -15 -20 -25 -30

- | | | | |
|---------------------------|-----------------------|---------------------|-----------------|
| A - Cold & cool plankton. | F - Total algae | K - Mollusca cool | P - Polar bear |
| B - Warm plankton. | G - Warm macrophytes | L - Crustaceae warm | Q - Whale |
| C - Total plankton. | H - Cold macrophytes | M - Pisces warm | R - Total fauna |
| D - Warm algae | I - Total macrophytes | N - Pisces cool | |
| E - Cold algae | J - Mollusca cold | O - Pisces cold | |

MARINE

BIOTA

ISOTOPE VALUES

FIGURE 6

Cana & Deevey 1960). Isotope ratios for fresh water plants resemble those of C_3 plants (i.e. they have lower ^{13}C contents than marine plants).

Parker (1964) has shown that the isotopic composition of marine animal tissues fall within the same isotope range as their food supply; and in noting this he suggested the use of stable carbon isotopes as dietary tracers in food chains. Similar conclusions were reached by Broecker and Ollsson (1961) and Keith et al (1964) on examination of $\delta^{13}C$ values derived from animal tissues. These studies have resulted in more detailed research on relationships between animal diets and carbon isotopes. De Niro and Epstein (1978) established that the total ^{13}C content of the storage tissues, excreta and CO_2 breathed out of an animal equals the ^{13}C content of its food base. Vogel (1976, 1978) has shown that ungulates which consume only C_3 plants develop a C_3 isotope composition. Similarly, those which consume C_4 plants show a C_4 isotope composition. Furthermore, ungulates consuming both C_3 and C_4 plants in varying quantities show mixed ^{13}C contents, from which the percentage contribution made by C_3 and C_4 plants can be determined. In his research, Vogel (1978) used specific fractions of animals such as bone collagen, hair, muscle and fat to obtain isotopic measurements. Muscle tissue and fat of ungulates were found to have an average $\delta^{13}C$ value closely resembling the plant food base. Bone collagen, a fibrous protein, proved to be enriched by approximately 6.1/mil with respect to the whole animal body and the diet (Vogel & Waterbolck 1967, 1972; Vogel 1978). Van der Merwe and Vogel (1978) have found human bone collagen to be enriched in ^{13}C by 5.1/mil

relative to the average ^{13}C content of the food source. This enrichment factor for bone collagen (5.1/mil) is used for calculations in this thesis and is discussed in more detail later.

In this chapter, the marine, terrestrial and fresh water carbon systems are discussed with reference to the isotopic composition of food sources available to humans, and with special emphasis on Eastern Cape.

THE MARINE CARBON SYSTEM

Photosynthetic plants are found in all parts of the oceans, but are mostly confined to depths of sufficient illumination termed the photosynthetic zone (Steeman-Nielsen 1975).

Three principal sources of carbon - carbon dioxide, bicarbonate and carbonate ions - are available to these plants (Harvey 1955). Free carbon dioxide in solution has a $\delta^{13}\text{C}$ value of -9/mil at 0°C and -6.8/mil at 30°C (Deuser and Degens 1967). These values show a depletion of ^{13}C in cold relative to warm waters. Oceanic bicarbonate has an average $\delta^{13}\text{C}$ value of 0/mil (Broecker 1972).

Marine organisms from different localities have yielded $\delta^{13}\text{C}$ values from -7.0/mil to -31.1/mil (Craig 1953; Park & Epstein 1961; Sackett et al 1965; Degens et al 1968b; Deuser 1977.) Table V describes the location, average surface temperature and the annual surface temperature range for four localities: Kielbight (Denmark), Bornholm (Denmark), Elands Bay (West Coast of South Africa), and Redfish Bay (Texas U.S.A.). They are

divided into three regions on the basis of temperature.

- a) Cold temperate, with a temperature range of 0° to 15°C (Kielbight & Bornholm).
- b) Cool temperate, with a temperature range of 10° to 15°C (Eland's Bay).
- c) Warm temperate, with a temperature range of 15° to 30°C (Redfish Bay).

Oceanic plankton from warm water regions show a mean $\delta^{13}\text{C}$ value of -20.68/mil, while plankton from cool and cold waters have a mean carbon isotope value of -25.68/mil, thus indicating an enrichment in carbon -13 in warm water plankton relative to cold. A similar pattern is observed in algae and macrophytes from coastal waters (Figure 6; Table IV). Macrophytes confined to the littoral benthic zones are enriched in ^{13}C with respect to oceanic plankton from the same temperature region.

Macrophytes grown in tidal regions or rock pools are subject to greater solar radiation, heat penetration and greater evaporation in shallow waters. These factors may increase water temperature, thus causing a further enrichment in ^{13}C relative to oceanic plankton. Other plants such as lichens, algae and even plankton found in the littoral zone will be similarly affected.

Carbon isotope contents of marine Mollusca in cold and warm waters vary because of their differing feeding habits. A cold water sample of filter-feeding bivalves from Kielbight (Figure 7; Table VI) show a ^{13}C enrichment of 4.0/mil with respect to cold water plankton (-28.68/mil). At Eland's Bay, cool water bivalves show a mean $\delta^{13}\text{C}$ value of -18.2/mil, and a mean of -15.71/mil

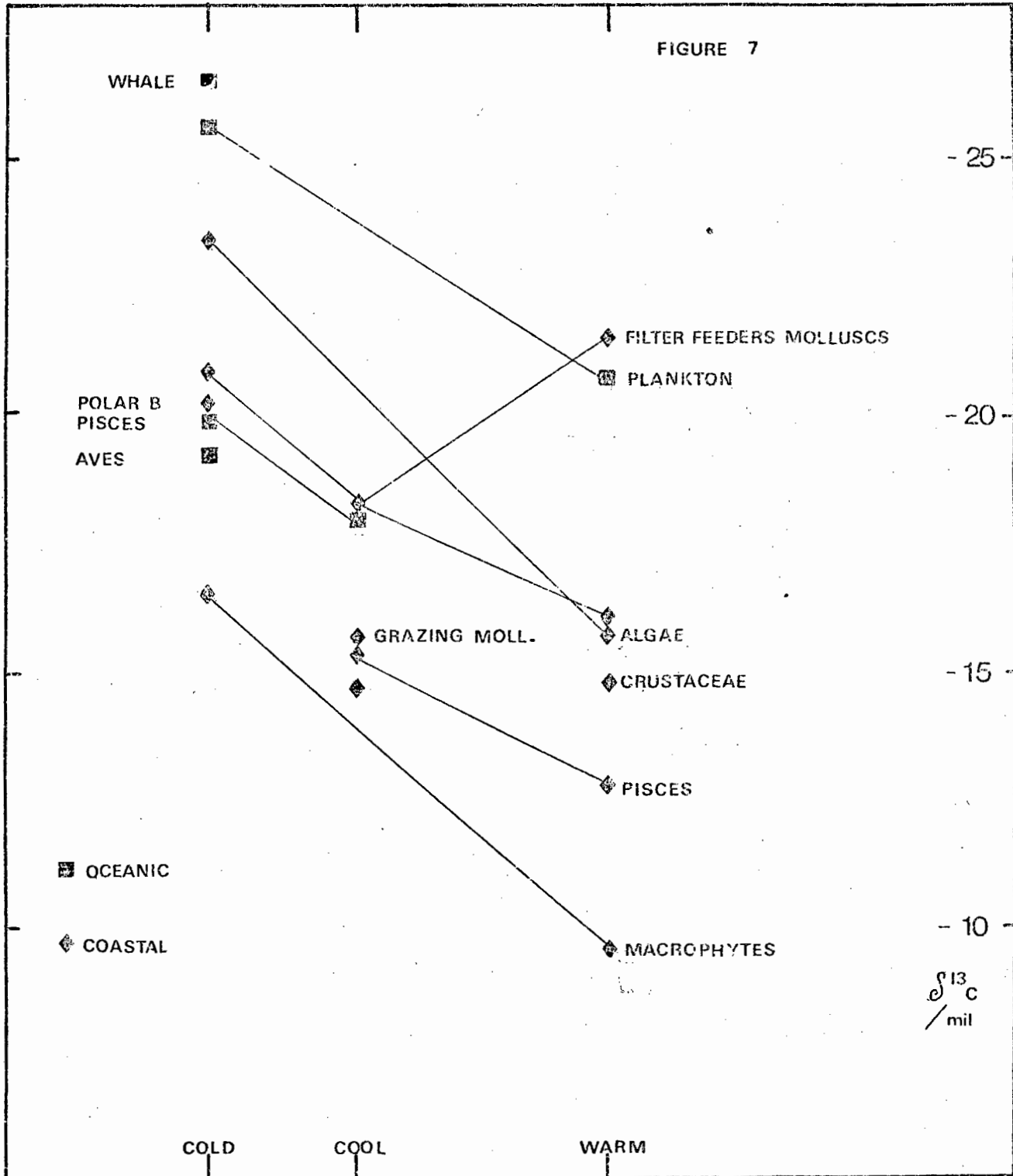
for grazing univalves. Both univalves and bivalves from Eland's Bay thus show an enrichment with respect to marine plankton found in these waters. The observed enrichment in ^{13}C in these molluscs can be attributed to the diet of both ^{13}C -depleted plankton in addition to coastal detritus which is enriched in the case of filter-feeders, and ^{13}C enriched coastal plants and detritus in the case of grazers. Clams and oysters (both filter-feeders) from Redfish Bay, a warm temperate region (Figure 7), show $\delta^{13}\text{C}$ values of -27.0/mil and -16.0/mil respectively. The clams show a ^{13}C content corresponding to that of cold water plankton (-28.0/mil), and the oysters show isotope values enriched in ^{13}C with respect to warm water plankton by approximately 4.0/mil, which is similar to the enrichment observed between cold water plankton and cold water filter-feeders.

Cold water fish from Europe are found to have more negative $\delta^{13}\text{C}$ values than fish from cool and warm waters. Oceanic fish are also found to be depleted in ^{13}C with respect to coastal fish from the same regions (Figure 7). Carbon isotope readings on marine birds and mammals are only available for Europe, a cold water region. Marine birds and polar bears have mean $\delta^{13}\text{C}$ values which show a remarkable similarity to the mean for European fish (marine bird: -18.3‰/mil, polar bear: -19.3‰/mil, marine fish: -19.9‰/mil). This is an expected result since fish form the principal food of polar bears and marine birds. Similarly, the Baleen whale from Europe (-25.6‰/mil) shows the same $\delta^{13}\text{C}$ value as the mean for cold water marine plankton (-25.6‰/mil), its primary food source.

FIGURE 7

Diagram showing the individual ^{13}C contents of marine biota from cold, cool and warm temperate regions.

FIGURE 7



From the above readings it is clear that despite a large range in marine carbon isotope determinations, valuable information concerning marine food chains can be obtained from ^{13}C abundance ratios, provided that the locality and water temperature is known. In general, it emerges that the $\delta^{13}\text{C}$ values of marine animals correspond to the carbon isotope composition of the food they eat.

The Eastern Cape marine biota falls within the faunistic province of South Coast Biota, which includes a few tropical species, but also many warm water endemics and some cosmopolitan forms (Day 1969). Average sea temperatures for the Eastern Cape are given in Table V. The average surface temperature is 18°C with an approximate annual surface temperature range of 14° to 25°C (McLachlan 1977). Plants and marine animals of the Eastern Cape thus fall into the warm temperate region. No carbon isotope determinations have as yet been made on marine plants and animals from the Eastern Cape. Knowing the average temperature range of this region it can be assumed that similar isotope readings can be attributed to the biota of this region as for the biota of warm temperate regions (i.e. Redfish Bay). Expected carbon isotope readings for marine biota in the Eastern Cape are given in Table VII. Average $\delta^{13}\text{C}$ values for plankton are $-20.6/\text{mil}$, marine algae $-15.7/\text{mil}$, marine macrophytes $-9.58/\text{mil}$, filter-feeding molluscs $-16.0/\text{mil}$, grazing molluscs $-13.0/\text{mil}$, Crustaceae $-14.8/\text{mil}$, fish (coastal) $-12.8/\text{mil}$, marine birds $-14.4/\text{mil}$, and large carnivores (seals) $-15.4/\text{mil}$.

THE TERRESTRIAL CARBON SYSTEM

Atmospheric carbon dioxide is the main source of carbon available to all forms of terrestrial plants. The average carbon dioxide content of the atmosphere is estimated to be 320 ppm (0.3%) by volume (Bolin 1970). Keeling (1958) has determined the $\delta^{13}\text{C}$ value of atmospheric carbon dioxide as -7.0/mil.

In the Eastern Cape, C_3 , C_4 and also CAM plants are found, with mean $\delta^{13}\text{C}$ values of -26.5, -12.5 and -16.6/mil, respectively (Figure 5). The majority of plants found in this region are C_3 plants, only certain grass species being C_4 . Little is known about the occurrence and distribution of CAM plants in the Eastern Cape. These are not considered to be important enough dietary staples in either human or animal diets to be relevant to this study.

The distribution of C_3 and C_4 grass species for Southern Africa has been determined by Vogel et al (1978). Figure 8 shows their frequency distribution for each of the Veld types delineated by Acocks (1975) for the Eastern Cape. From this diagram it is clear that seven of the vegetation types represented in the Karoo region have a 95% to 100% C_4 grass component (Veld types: 21, 26a, 30, 31c, 37, 38, 50). The remainder range from 25% to 95% in C_4 grass composition (Veld types: 44a, 24, 26b, 26c, 42, 60, 25). The Cape Folded Belt, which supports False Macchia (70), shows the lowest C_4 percentage of 5% to 25%. C_4 grasses do, however, increase in frequency towards the eastern regions of the folded mountain belt. On the coastal plain, the Valley

FIGURE 8

Map of the Eastern Cape Region showing the percentage cover of C_4 versus C_3 grasses (After: Vogel et al (1978)).

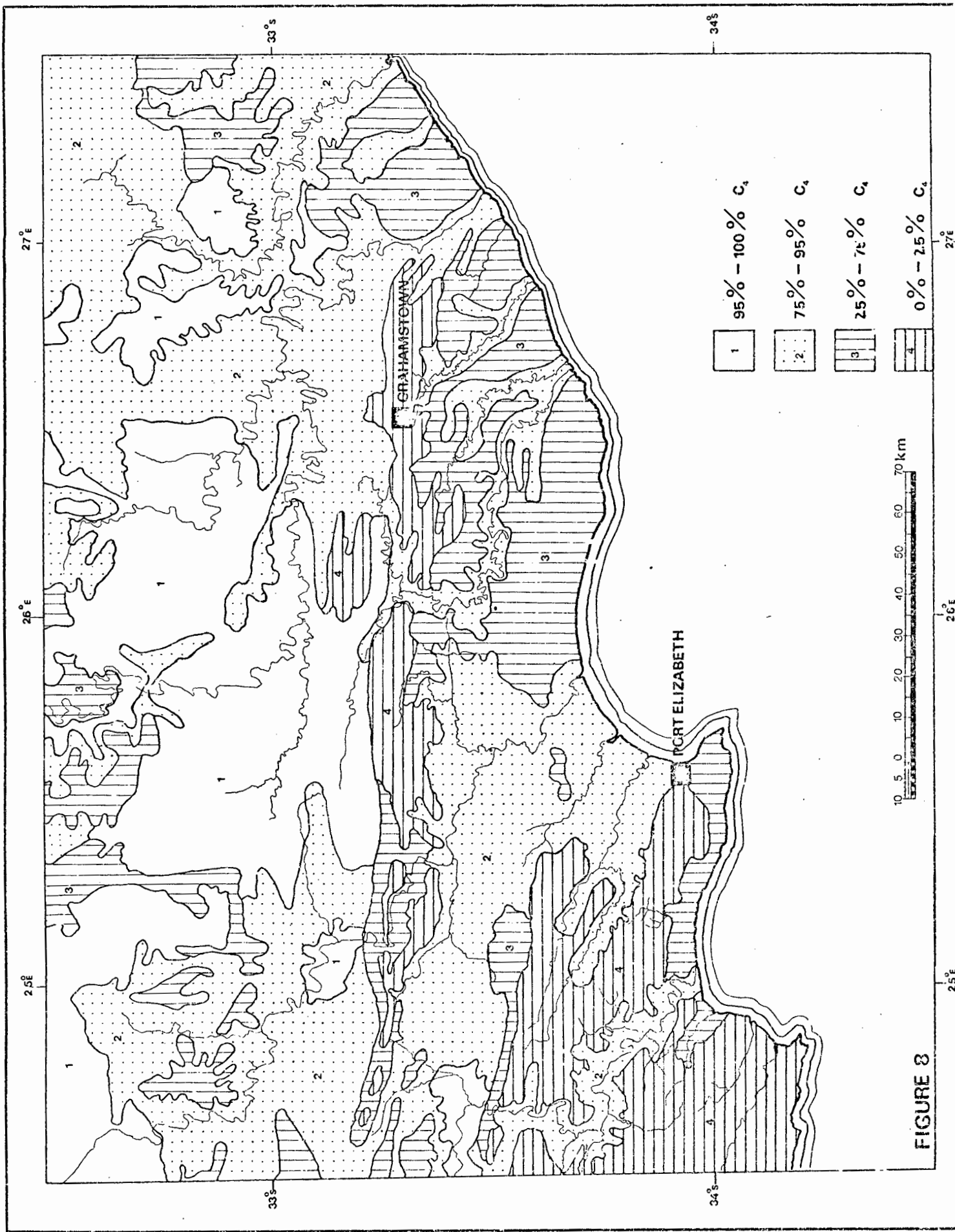


FIGURE 3

Bushveld types (23b to e) have a 75% to 95% C_4 grass composition, while the Coastal Forest types and the southern part of the Eastern Province Thornveld have C_4 ranges between 25% and 75%.

It is possible that the distribution of C_4 grasses in the Eastern Cape may have altered during the Holocene. Little is known about the shift in distribution of C_4 grasses in relation to past climatic change. During cooler periods it is possible that C_3 grasses dominated at the expense of C_4 grasses. C_4 plants are known to have sub-tropical or arid affinities : the C_4 - Dicarboxylic Acid photosynthetic pathway is considered to be an evolutionary adaptation to a growth season with high temperatures and radiation (Laetsch 1969; Björkman et al. 1971). Butzer and Helgren (1972), on the basis of sedimentological evidence, propose a period of temporary forest advance in the southern Cape dated to approximately 7000 B.P. After this period coastal vegetation becomes more open and slopes unstable. Mesic conditions prevailed between ca. 4000 and 1000 B.P., with a period of aridification thereafter. From this evidence it can be suggested that C_3 grasses dominated in the Eastern Cape before 7000 B.P. and that after this period C_4 grasses appeared.

Most carbon isotope readings on humans and animals have been determined on bone collagen, which is enriched by 5.1/mil relative to the average ^{13}C content of the carbon source (i.e. plant food). This enrichment factor was determined on a sample of 31 North American Indian skeletons whose readings were used to calculate the shift in isotope composition between the base of the food web (-26.5/mil), and human bone collagen

(-21.4/mil) (Van der Merwe & Vogel 1979). $\delta^{13}\text{C}$ collagen readings on browsing ungulates (C_3 plant feeders) from Southern Africa show a mean value of -21.2/mil, a value closely similar to that obtained from the North American Indian sample (the difference may be due to a small C_4 contribution in the browsing diet). Collagen readings on mixed grazers and pure grazers combined show a mean $\delta^{13}\text{C}$ value of -9.7/mil; the higher ^{13}C content is a result of the consumption of C_4 grasses (Vogel 1978). If the collagen enrichment factor of 5.1/mil is subtracted from these isotope readings, $\delta^{13}\text{C}$ values for meat can be calculated to average -26.5/mil, and for mixed feeders/pure grazers -14.8/mil. As no direct ^{13}C determinations are available for ungulates in the Eastern Cape, these $\delta^{13}\text{C}$ values will be used in the analysis which follows.

As the Eastern Cape shows a mixed distribution of C_3 and C_4 grasses, the isotopic composition of mixed feeders will not be the same in some localities as others. On the coastal plains and the interior where C_4 grasses dominate similar $\delta^{13}\text{C}$ values on mixed feeders as obtained in the interior can be expected, but in the Folded Mountain belt where C_3 grasses dominate, mixed feeders would have more negative ^{13}C compositions. However, both the coastal plain and the interior are areas known to have supported herds of grazing ungulates, therefore a $\delta^{13}\text{C}$ content of -14.8/mil for these animals can be expected. For the purposes of this study, grazers and mixed feeders are combined into a single category termed 'mixed feeders'. Eastern Cape browsing ungulates are thus expected to have a mean $\delta^{13}\text{C}$ value for meat of -26.5/mil, while mixed feeders are expected to average -14.8/mil. These values may have changed with time as the distribution of C_4 and C_3

grasses in this region possibly fluctuated with changing climatic conditions. It has already been suggested that C_4 grasses dominated in this region after 7000 years B.P., which would mean that the average $\delta^{13}C$ value of a mixed feeder would have been more positive than before 7000 B.P., when C_3 grasses dominated.

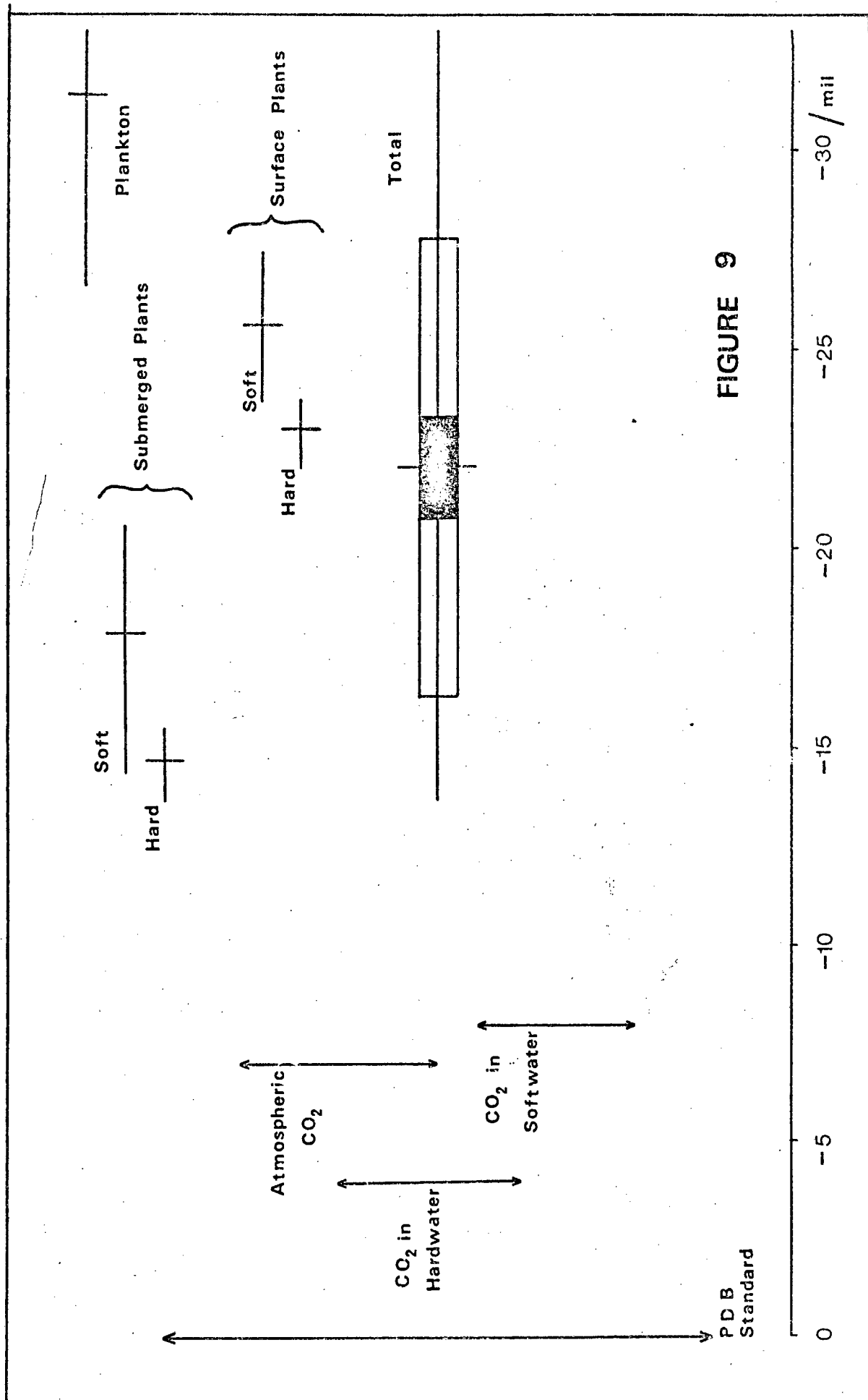
THE FRESH WATER CARBON SYSTEM

Inland waters range from solutions chemically similar to distilled water to highly carbonate brines, in which the total carbon dioxide content exceeds several moles per litre (Wentzel & Rich 1972). As in sea water, most fresh water carbon occurs as equilibrium products of carbonic acid, some carbon occurs as organic compounds in dissolved particulate detrital carbon. Carbon dioxide in fresh water has an average ^{13}C content of -7/mil. Bicarbonates and carbonates have a ^{13}C content of 0/mil. In hard waters, the ^{13}C content of carbon dioxide in solution averages -4/mil. This isotope value shows an influence from carbonates in solution on the overall isotopic composition. Carbon dioxide in soft waters have an average $\delta^{13}C$ value of -8.0/mil (Figure 9) (Jana & Deevey 1960).

Wickman (1952) found that the ^{13}C content of fresh water plants varied from -10 to -28/mil, which covers the isotope range of terrestrial and marine plants. In general, plants in soft water have $\delta^{13}C$ values like C_3 plants and plants in hard water have $\delta^{13}C$ values like C_4 plants. There are several important rivers in the Eastern Cape whose waters vary from a soft state after rain to a semi-hard state during periods of drought.

FIGURE 9

Modified Dice-Leraas diagram for the ^{13}C content of fresh water plants. The horizontal lines show the observed ranges; rectangles mark the standard deviation; with the shaded area indicating the standard error; the vertical line indicates the mean.



Rainfall is not strictly seasonal in this region, and thus river water remains soft except in periods of low rainfall. On the whole, fresh water plants would have a similar carbon isotope composition as do C_3 plants (Figure 9), except during drier periods when they would be slightly enriched. Table VIII shows the $\delta^{13}C$ values for plankton and mussels from fresh water habitats in the U.S.A. Where the total hardness of the water causes variations in ^{13}C content, the sample average is -31.06/mil. Thus plants in these habitats fall into the same carbon isotope range as C_3 plants. Many species of fresh water fish occur in the Eastern Cape as well as the mussel Cafferia caffer. Fresh water fauna in the Eastern Cape reflect isotope values in the C_3 plant range.

SUMMARY

In this chapter the expected $\delta^{13}C$ values for marine fauna in the Eastern Cape is derived from localities showing similar environmental conditions.

The derived marine average is approximately -14.0/mil, similar to that of Redfish Bay, a warm temperate region. C_3 plants dominate the terrestrial vegetation, with C_4 grasses common in the interior and coastal plain. Expected $\delta^{13}C$ values for the meat of animals consuming only the C_3 plants are approximately -26.5/mil and for those which consume both C_4 and C_3 plants -14.8/mil. Fresh water biota are expected to have isotope values in the C_3 plant isotope range. Where conditions of hard water prevail, a slight ^{13}C enrichment in fresh water flora and fauna can be expected.

CHAPTER IV

ISOTOPE CHARACTERIZATION OF HOLOCENE HUMAN DIETS IN THE EASTERN CAPE

In the preceding two chapters aspects of diet and subsistence of Holocene populations were discussed, as well as the carbon isotope composition of marine and terrestrial flora and fauna of the area. By combining these two bodies of data it becomes possible to predict the carbon isotope composition of hunter-gatherers, pastoralists and agriculturalists who lived in the region under defined conditions. Such predictions are provided in this chapter. These are arrived at by averaging the isotope composition of different food webs, as based on archaeological conclusions and by varying these for a given set of circumstances. The predictions can then be compared with actual results obtained from human skeletons as provided in chapter VI.

Since skeletons are almost the only human remains in archaeological contexts the predicted values provided here are those expected for bone collagen (enriched by 5.1/mil from food source). It should be stressed that collagen is chemically highly active in growing children, but becomes progressively inert with increasing age. Libby et al (1964) has estimated the carbon turnover rate of adult human collagen at greater than 10 years. It can be accepted that the collagen of an adult human reacts very slowly and hence provides an isotopic reading which averages the food intake of 10 years or more. Under these conditions the principal diet staples overwhelmingly determine $\delta^{13}\text{C}$ values and short term changes are specifically not registered. Seasonal fluctuations are therefore averaged out. The situation is

almost certainly different in young children in whom active collagen synthesis is proceeding (Libby et al 1964; van der Merwe pers. comm.). To provide the predicted values for the populations under consideration, it is necessary to know the average $\delta^{13}\text{C}$ values of their food staples and the relative quantities consumed. Such values are provided here and averages are calculated for various phases of the Eastern Cape archaeological sequence.

FOOD STAPLES IN THE HOLOCENE

Plant foods.

The principal edible plants and their carbon isotope status identified from Melkhoutboom Cave, Scotts Cave and Springs Rock-shelter (Wells 1965; H.J. Deacon 1976), are listed in Table IX. These plants are found to be common to both Wilton and Pottery Wilton levels. All species listed in the above table are C_3 plants which would give a mean $\delta^{13}\text{C}$ content of -26.5/mil. Humans consuming only these plants would have a resultant collagen $\delta^{13}\text{C}$ value of -21.4/mil.

Domesticated plants known to be plant staples in the diet of agriculturalists are named in Table IX. From historical records these plants were consumed by people living in the Eastern Cape within the last 500 years B.P. (Wilson 1969). These domesticates are C_4 plants and have a mean $\delta^{13}\text{C}$ content of -12.5/mil. Collagen $\delta^{13}\text{C}$ values in humans who have consumed only these plants will approximate -7.4/mil.

Terrestrial Animals.

The frequency of browsers (consuming only C_3 plants) and mixed feeders combined with pure grazers (consuming only C_4 plants or a mixture of both C_3 and C_4 plants) identified from caves such as Melkhoutboom, Nelson Bay, Klasies River Mouth, Scotts Cave and Wilton Large Rock-shelter (J. Deacon 1972; Klein & Scott 1974; Klein 1974, 1976; H.J. Deacon 1976), are given in Table I and in addition individual site and total combined site frequencies of browsers and mixed feeders for the Albany, Wilton and Post-climax Wilton phases are tabled. The mean $\delta^{13}C$ value for the meat of browsers is -26.5/mil, while the mean for mixed feeders is -14.8/mil. Using these isotope values and the frequencies it is possible to calculate the mean expected $\delta^{13}C$ values for meat consumed by Albany (browsers 40% ; mixed feeders 60% = -19.4/mil), Wilton (browsers 70% ; mixed feeders 30% = -22.9/mil) and Post-climax Wilton (browsers 70% ; mixed feeders 30% = -22.9/mil) hunter-gatherers.

Milk and meat from cattle and sheep are known staples of the early Cape pastoralists; game also contributed to a lesser degree, to their diet (Shapera 1930). It is suggested that up to 80% of the pastoralists' animal food was derived from cattle and sheep (mixed feeders) and the remainder from other browsing animals. Similar estimates can be made for the animal diet of agriculturalists.

Estimated $\delta^{13}C$ values for the meat consumed by pastoralists and agriculturalists are -17.1/mil for pastoralists (browsers 20% ; mixed feeders 80%) and agriculturalists -15.9/mil (browsers 10% ; mixed feeders 90%) (Table X).

The estimated carbon isotope values for meat consumed by hunter-gatherers, pastoralists and agriculturalists depend on one factor - the presence or absence of C_4 grasses in the Eastern Cape during the Holocene. If absent, all animal $\delta^{13}C$ values will be C_3 in isotope composition (since there are only C_3 grasses to eat), and will present a $\delta^{13}C$ composition of -26.5/mil (Table X).

Other terrestrial and Aquatic foods.

Other terrestrial foods identified in cave deposits are listed, of which ostrich egg shell and fresh water mussel are present in sufficient quantities to merit discussion (Table XI). Ostrich egg is common in Wilton phases at Melkhoutboom and Wilton Large Rock-shelter (Table XI). Being a mixed feeder an ostrich would be enriched in ^{13}C providing C_4 grasses were present in this region. Fresh water mussels are exploited after 3000 years B.P., and because of their fresh water habitat are found to be depleted in ^{13}C , falling within the C_3 plant carbon isotope range (Chapter III).

Marine foods.

At coastal sites in the Eastern Cape Perna perna (a filter-feeding bivalve), Patella spp. (a grazing univalve), Turbo spp. (grazer), and Haliotis spp. (grazer) represent the principal food remains. Other dietary items include coastal fish, seals and marine birds such as cormorants and penguins. A third component is represented by terrestrial animals such as duiker, bushbuck, bushpig and tortoise (Schonland 1896, 1903; Leith 1899; H.J. Deacon 1970; Cairns 1975). It is estimated that up to 80% of the food remains represented in coastal sites are of

marine origin and the remainder of terrestrial origin. In midden deposits both filter-feeders and grazing molluscs are prevalent. The frequencies of these two molluscan categories are represented in Table XII, from three sites in the Eastern Cape - Storms River 1 and 2 and the Escourt midden (H.J. Deacon 1970; Cairns 1975). These figures provide an overall estimate of 60% grazers and 40% filter-feeders from these sites. These frequencies can be used to estimate the overall $\delta^{13}\text{C}$ composition of shell fish in the marine diet of the coastal inhabitants.

Since little quantitative data concerning the relative importance of Eastern Cape seals, marine birds and fish in human diets is available the relative importance of marine foods is estimated qualitatively in Table XIII, from which the average $\delta^{13}\text{C}$ content for all marine foods are determined. The $\delta^{13}\text{C}$ values for individual marine foods are taken from Table VII.

Seals and marine birds are considered to be of equal dietary importance; they give a $\delta^{13}\text{C}$ value of -14.9/mil. Seals and marine birds combined are considered to be more important than marine fish and a $\delta^{13}\text{C}$ value of -14.0/mil is derived from these food sources (Table XIII). From archaeological evidence 60% of the shellfish consumed are grazers and 40% are filter-feeders and these percentages are accepted as an indication of the dietary importance of shellfish - a $\delta^{13}\text{C}$ value of -14.2/mil is given for these marine foods. When shellfish are compared with other food sources (seals, marine birds and fish), it is estimated that marine molluscs form approximately 70% of the total marine diet, giving a total average marine $\delta^{13}\text{C}$ value of -14.1/mil (Table XIII).

As the above table is presently constituted, any change in the consumed quantity of the listed marine foods will not significantly alter the overall marine average.

EXPECTED ^{13}C VALUES FOR DIFFERENT POPULATIONS

The mean $\int^{13}\text{C}$ values for browsing animals (-26.5/mil), mixed feeders (-14.8/mil), C_3 plant foods (-26.5/mil), C_4 domesticated plants (-12.5/mil) and marine foods (-14.1/mil), are used to calculate the mean expected carbon isotope composition of Albany, Wilton and Post-climax Wilton hunter-gatherers and in addition pastoralists and agriculturalists (Table XIV). The overall expected ^{13}C content is calculated by first estimating the importance of browsers versus mixed feeders and the overall animal ^{13}C content is compared with the contribution of plants giving a total terrestrial food $\int^{13}\text{C}$ value. This value is then compared with the marine food contribution resulting in an overall estimate of the expected ^{13}C content of the people studied.

Albany populations.

The mean expected $\int^{13}\text{C}$ value for Albany populations is given, assuming a total absence of C_4 grasses in the Eastern Cape during this time. The terrestrial diet is found to be totally C_3 in isotope composition, the only ^{13}C enriched foods are marine foods (Table XV). Archaeological evidence suggests that the contribution of marine foods in the diet of Albany populations is low, probably in the order of 10% (Chapter 11). With this in mind the overall expected isotope composition of human bone collagen would be in the order of -20.1/mil (Table XV).

The overall expected $\delta^{13}\text{C}$ value is also calculated for Albany populations in the Eastern Cape while assuming the presence of C_4 grasses in this region. Archaeological evidence suggests that browsers constitute approximately 40% and mixed feeders 60% of the overall animal diet (Table XV). As there is no record of the presence of C_4 plants in the diet of Albany peoples the plant diet is expected to be C_3 in isotope composition. In the terrestrial diet it is estimated that animals constitute up to 70% and plants 30%, supporting the suggestion that these populations are primarily hunters of game. Marine foods have been estimated as constituting approximately 10% of the overall diet. The expected $\delta^{13}\text{C}$ value of human bone collagen with C_4 grasses present is thus -15.7/mil. This figure shows an enrichment in ^{13}C as a result of the consumption of enriched foods such as mixed feeders and marine foods (Table XV).

Wilton Populations.

The expected $\delta^{13}\text{C}$ values are given for the Formative, Developed Climax and Post-climax phases of the Eastern Cape Wilton sequence (Table XVI). For Formative, Developed and Climax populations it is estimated that browsers constitute up to 70% and mixed feeders 30% of the animal diet and in the overall terrestrial diet plant foods constitute 70% and animal foods 30%. In the overall diet marine foods constitute approximately 30%. The above estimates are based on archaeological inference (Chapter II). The expected mean obtained gives a human collagen $\delta^{13}\text{C}$ value of -16.9/mil. for Developed, Formative and Climax Wilton individuals (Table XVI). These calculations assume the presence of C_4 grasses in the Eastern Cape; if no C_4 grasses

were present in this region at this time the mixed feeder component in the diet will be C_3 in isotope composition, resulting in an overall $\delta^{13}C$ human collagen value approximating -17.6/mil.

The estimated carbon isotope composition of Post-climax populations is given in Table XVII. It is expected that these people consume a larger amount of marine foods, thus giving rise to a further enrichment in the overall $\delta^{13}C$ content (Chapter II). It is estimated that up to 50% of the overall diet is made up of marine foods, giving a $\delta^{13}C$ value for human bone collagen of -14.6/mil. If no C_4 grasses were present in this region during the Post-Climax phase an expected collagen $\delta^{13}C$ value of -15.2/mil is obtained.

Pastoralists.

The mean expected $\delta^{13}C$ value for pastoralists in the Eastern Cape is calculated in Table XVIII. In the animal diet the percentage contribution of mixed feeders is high (80%) and browsers low (20%); in the overall terrestrial diet the contribution of animal foods is also high (70%), and C_3 plant foods low (30%). Marine foods are not believed to be important in the overall pastoralist diet, approximating 20% and the terrestrial food component 80%. The expected collagen isotope composition of these pastoralists approximates -13.6/mil (Table XVIII).

Pastoralists/Agriculturalists.

The expected carbon isotope composition for pastoralists who have adopted agriculture in the form of domesticated crops such as maize, sorghum and millet is determined in Table XIX. These cultigens are all C_4 plants and a significant intake of them in the diet would further enrich the overall human collagen isotope composition. If these plant foods were incorporated in the diet, it is possible that they would replace other plant foods such as C_3 plants, marine foods and that the overall animal dietary component would decrease.

It is estimated that mixed feeders constitute approximately 90% of the overall animal diet, the remaining 10% being composed by browsers. Thus, once domestic crops are included in the overall diet, animals are expected to decline in importance, and marine foods play a lesser role in the overall diet. Estimated $\delta^{13}C$ collagen values for these folk would approximate -8.7/mil.

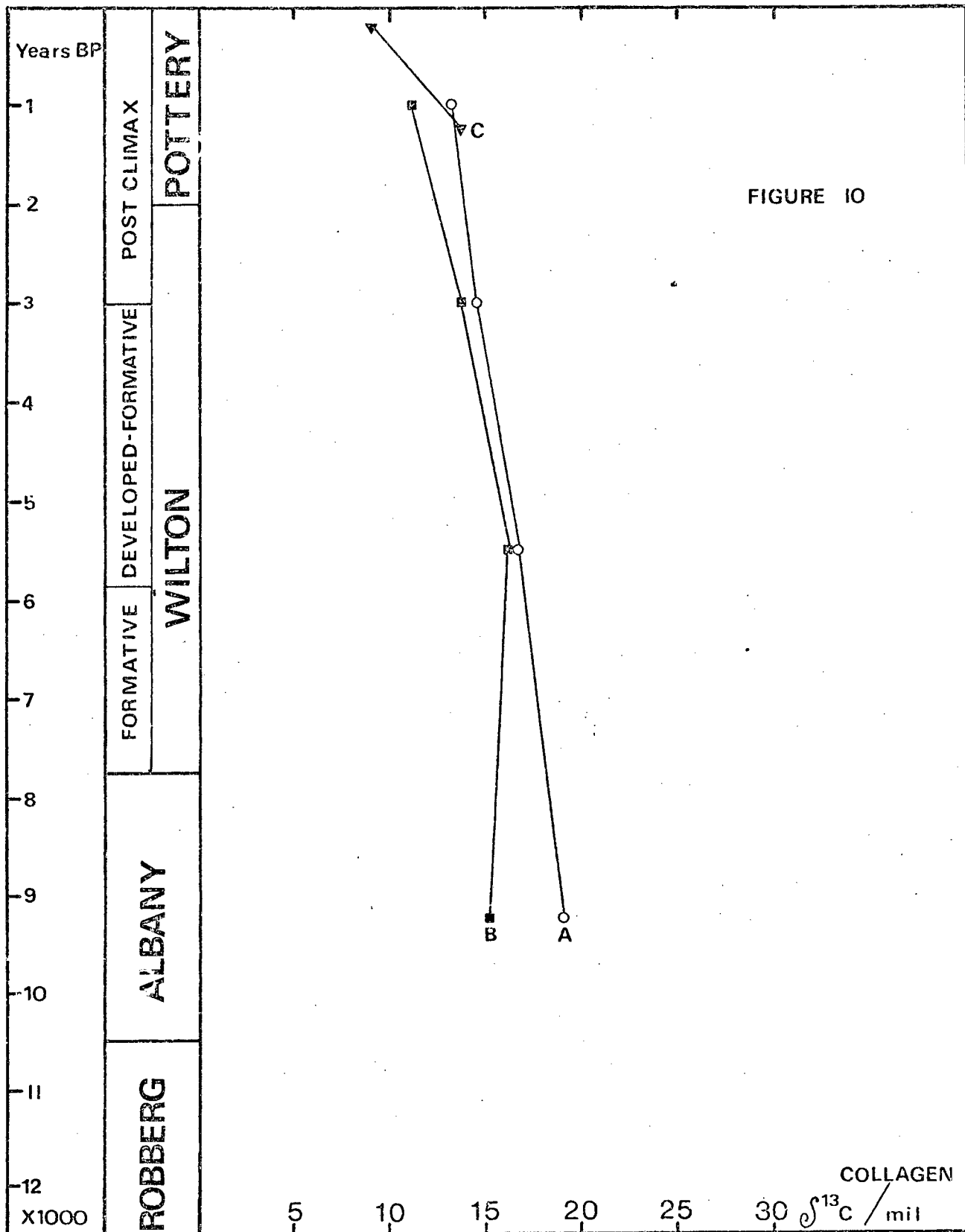
SUMMARY

The qualitative assessment of the importance of the principal foods in the diet of Holocene populations in the Eastern Cape are summarized in Figure 10. The mean $\delta^{13}C$ values anticipated for bone collagen of Albany populations is -20.1/mil (no C_4 grasses) or -15.7/mil (C_4 grasses present). For Formative, Developed and Climax Wilton populations the expected $\delta^{13}C$ value is -16.9/mil (C_4 grasses present), or -17.6/mil (C_4 grasses absent). Post-climax Wilton populations have an expected $\delta^{13}C$ value of -14.6/mil or -15.3/mil (no C_4 grasses present).

FIGURE 10

Diagram showing the mean expected ^{13}C contents of Holocene populations in the Eastern Cape.

A - indicates hunter-gatherer populations whose overall diet was not affected by the presence of C_4 grasses. B - indicates hunter-gatherer populations whose overall diet was affected by the presence of C_4 grasses. C - shows expected trends for pastoralists & agriculturalists.



Expected $\delta^{13}\text{C}$ values for pastoralists are -13.6/mil and for pastoralists/agriculturalists -8.7/mil. These expected carbon values show that if C_4 grasses were present in the Eastern Cape region during the Holocene both Albany and Wilton populations will show similar $\delta^{13}\text{C}$ values, but an enrichment in ^{13}C is expected in Post-climax individuals, and a further enrichment in pastoralists and agriculturalists. If no C_4 grasses were found in this region during the Holocene, however, individuals from the Albany, Wilton (formative, developed and climax) and Post-climax Wilton could be separated on the basis of their carbon isotope content. Pastoralists would show similar $\delta^{13}\text{C}$ values to the Wilton hunter-gatherers, but agriculturalists would show a further enrichment in ^{13}C .

CHAPTER V

THE SKELETONS AND THEIR GRAVES

This chapter describes the burial practices or forms of body disposal after death practised by Holocene populations in the Eastern Cape (Figure 2), as they relate to the skeletons analysed in this study. It is probable that the presence of two socio-cultural groups (Bushmen/hunter-gatherers) and (Hottentots/pastoralists), and possibly a third (Iron Age agriculturalists) were registered in the archaeological record by different burial procedures. The burial sample used in this study (Appendix A) is analysed in order to isolate specific ritual forms (i.e. body placement, burial covering etc) which would be specific to hunter-gatherers, pastoralists and agriculturalists in this region, providing a separation of the skeletal sample into different socio-cultural groups. These divisions are tested against dietary implications arrived at through the carbon isotope analysis.

BURIAL PRACTICES IN THE EASTERN CAPE

Methods of burial analysis.

Sixty seven skeletons from the Albany Museum were selected for isotope analysis of which thirty-nine provided sufficient information on mode of burial to be used in this analysis of mortuary practices in the Eastern Cape. Information about these burials came from excavation reports in the Skeletal Accession Register (Albany Museum, Grahamstown), field notes,

private notes, correspondence and published works. The age, sex and number of individual skeletons were determined where possible by physical anthropologists A. Morris (University of the Witwatersrand) and A. Hausman (State University of New York at Binghamton).

Information about burial site (Figure 2), burial covering, body position, shaft preparation, associated materials, sex and age are given for each burial in Appendix A. Thirty-nine of these burials spanning a time range from approximately 8000 to less than 1000 years B.P. provide adequate information for analysis (Table XX).

In Table XXI, eight categories common to burials are listed which are further sub-divided into sub-categories representing attribute state combinations. Attributes of each burial are listed within each category. By means of the Chi-square test (Siegel 1956:108), the frequencies in each sub-category are used to determine the significance of the differences between categories. The frequencies in some attribute state combinations are too few in number to fulfil the sample requirements for the Chi-square test; where possible these are combined while in other cases they are deleted (Table XXI).

In category A (location), the sub-category 3 (open coastal burial) is combined with sub-category 2. In category B (burial covering), sub-categories 6 and 7 (nothing and not recorded) are not included in the analysis. In category C (body position), sub-category 11 (indeterminate) is deleted. In category D (shaft preparation), sub-categories 12, 13, 14 and 15 are combined,

while 16 remains on its own. In category F (associated material-specific), items of personal adornment and ochre (sub-categories: 21, 22, 24) and pottery and undiagnostic bone are similarly grouped (sub-categories: 20, 23). Category G is not included in the analysis because of indeterminate sexing. In category H (age), the sub-categories 29, 30, and 31 (infants, child, juvenile) are combined as are sub-categories 32, 33, and 34 (sub-adult, young adult, adults), and 35, 36 (mature and old adults). Category E (associated material - general) remains unchanged (see Table XXI for combined totals).

Results and Discussion.

Table XXII illustrates the extent to which each pair of categories could be considered to be independent. 'Zeros' represent non-significant Chi-square readings at $p=0.05$, and therefore suggest independence. 'Asterisks' are significant Chi-square readings suggesting non-independence. Categories E (associated material-general), and H (age classes), show complete independence.

The following pairs of attributes are significantly correlated:

- (a) Burials in caves correlate with grave coverings of slab(s) or rock(s). Open burials are associated with stone cairns.
- (b) Burials in caves show the side-flexed body position to be common and in open burials the vertical-flexed body position is common.
- (c) Cave burials have little or no shaft preparation, while there is a high degree of shaft preparation in open burials.

- (d) Graves with slab(s) or rock(s) covering them are associated with a body lying in the side-flexed position, while cairn burials are correlated with the vertical-flexed position.
- (e) Slab(s) or rock(s) are not correlated with shaft preparation but stone cairns are associated with a high degree of shaft preparation.
- (f) The side-flexed body position is never associated with shaft preparation whereas the vertical-flexed body position is.
- (g) Bodies interred in the side-flexed position are associated with items of adornment such as beads, pendants and ochre. The vertical-flexed body position is not significantly associated with associated materials.

Looking at these results two groups emerge:

- (1) People who buried their dead in the side-flexed position in caves placed ochre in the grave together with items of adornment such as beads and pendants. The graves were usually shallow and capped with slab(s) or rock(s).
- (2) People who buried outside caves positioned the body in the vertical-flexed position. Grave shafts were in many instances packed with stones on, around, above and below the deceased. The burial covering consisted of a cairn.

From this analysis differences can be drawn between cave and open burials. Are these differences a consequence of location as the Chi-square test indicates? If the coastal burial sample is examined several features common to cave burials are present (Table XXI). Two coastal burials have skeletons documented in

the side-flexed position and another includes associated materials such as shell pendants and ochre. Other burials from coastal localities, namely the South Cape coast, are documented as having the body in the side-flexed position (Avery 1977:92). *Bibliography says 1976!!*

Excavations undertaken by Fitzsimons (1923) at an open site in the Zuurberg Mountains, Eastern Cape reveal eight burials all positioned in a side-flexed position and covered with flat stones. Evidence of ochre and items of adornment in some of these burials are recorded. These examples suggest that the mode of burials described for caves is not restricted to one locality but is widespread. No cairn burials, however, are recorded in caves.

Ethnographic and historical accounts of Bushmen burial practices (the term 'Bushman' is here used in the historical sense) (Stow 1905: 126; Bleek 1928:16; Roos 1930:82; Schapera 1930:160) show a marked similarity to the burials of the cave-dwellers of the Eastern Cape (Group 1). In most accounts of Bushmen burials the side-flexed body characterises the position of the deceased. Body preparation in some cases include the anointing of the head with red powder, mixed with fat (Basutoland Bushmen). Associated materials include personal possessions such as clothes and artefacts used for the procurement of food. Shaft preparation is absent and forms of grave covering vary from no covering to thorn branches, but in most cases slabs or rocks feature prominently. In Bushman groups it is evident that the mode of internment does not differ on the grounds of sex and age. However, records do mention the abandonment of the aged and injured before death in times of hardship.

Early accounts of the mortuary practices of Hottentots (pastoralists) (Dapper 1668; Barrow 1806; Campbell 1815; Biden & Kling 1911; Shapera 1930:357-366; Laidler unpublished) show that the body is in many cases placed in a niche dug out from the side of the grave shaft. Variations such as the placement of the body on the back in the horizontal position have been noted amongst recent Hottentot groups. The floor of the grave is covered with twigs and bushes, and large flat stones are placed over these, closing the entrance to the niche. The grave is filled with sand and a mound of stone is placed over it; in some cases these mounds are extensive. In the majority of cases, associated material is not placed with the body, although occasionally objects are found. Hottentots, like the Bushmen, did not alter their mortuary practices on the grounds of sex or age, although abandonment occurred in special cases. This summary of Hottentot burial practices shows a strong resemblance to the group 2 burials from the Eastern Cape, except that the Eastern Cape sample does not record the presence of the niche. The absence of this feature may be attributed to the haphazard digging techniques adopted by early excavators.

Little evidence is available on the burial practices of the early Iron Age agriculturalists in the Eastern Cape. Hunter (1961) briefly mentions certain aspects of Pondo burial practices. It is evident that the vertical-flexed form of body placement was used and the niche was also a feature of early Pondo burials. The body was walled up in the niche with sods of earth, and the grave was filled with earth, stones and thorns which were also placed on top of the grave. It is

believed that only important persons were buried (i.e. chiefs and headmen), while commoners were thrown into the bush. It is not known whether associated materials were placed in early Pondo burials, but recently all personal belongings owned by the deceased were buried with him. If recent and past aspects of Pondo burial practices are combined as examples of early Iron Age agriculturalists burial patterns in the Eastern Cape, two elements, the body position and shaft preparation, are common to group 2. The absence of cairns and the presence of associated materials are characteristics of group 1. The possibility that only important people were afforded this type of burial exists.

When comparing ethnographic and historical evidence about burials with the Eastern Cape archaeological sample, two distinct burial patterns can be seen in both sets, namely those of Bushmen (hunter-gatherers) and Hottentots (pastoralists). Three key variables relating to hunter-gatherers and pastoralists can be isolated, independent of time and space.

- (a) Slab(s) or rock(s), side-flexed and associated items of adornment. (bushmen/hunter-gatherers).
- (b) Cairns, vertical-flexed and shaft preparation (hottentot/pastoralists) (Figure 1.1).

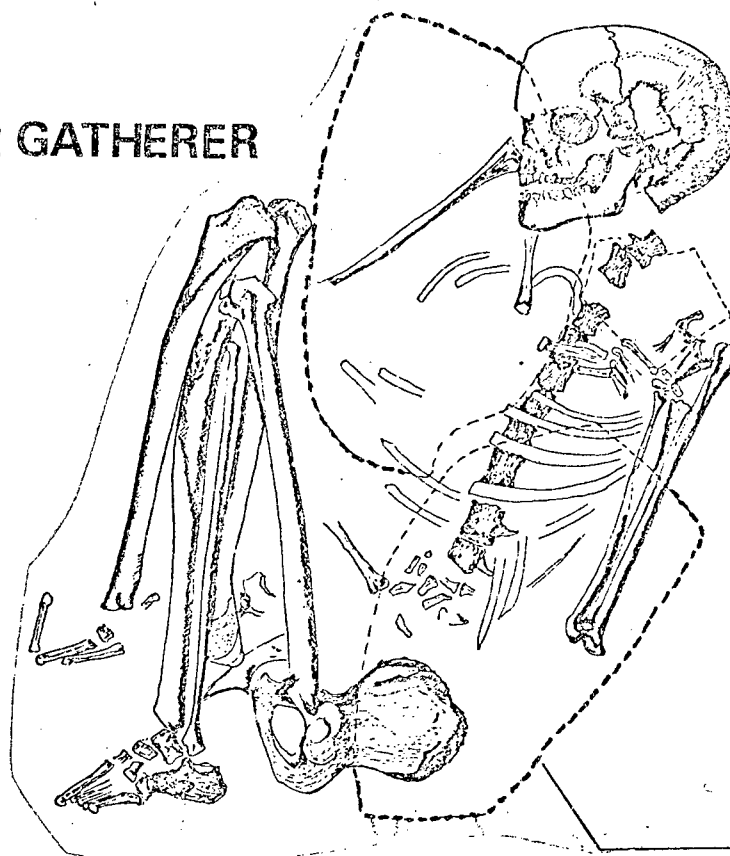
Characteristics of the mortuary practices of Eastern Cape hunter-gatherers and pastoralists can thus be identified;

- (1) Burials with a grave covering of slab(s) or rock(s) with the body interred in the side-flexed position together with

FIGURE 11

Diagrams showing examples of a plan view of a typical hunter-gatherer burial and a section through a Namaqualand pastoralist burial (Date: Parkington & Poggenpoel (1971); Laidler unpublished).

**PLAN
HUNTER GATHERER**



OUTLINE OF
BURIAL STONE

**SECTION
PASTORALIST**

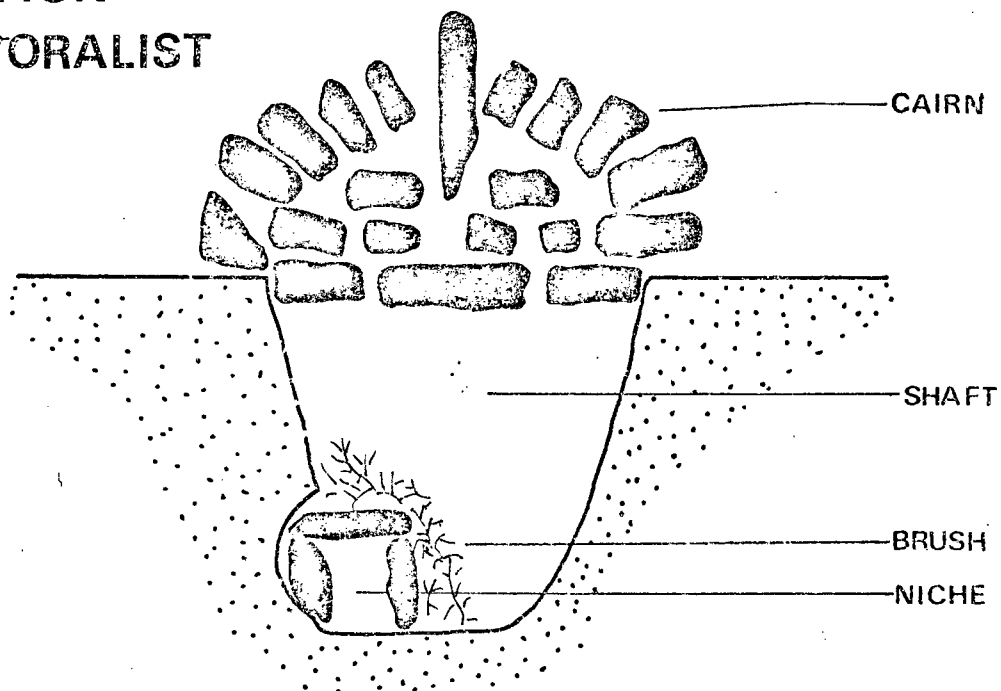


FIGURE II

associated objects such as beads, pendants and ochre are considered key ritual forms characteristic of hunter-gatherer/ bushmen burial practices and are independent of the age of deceased, and burial.

- (2) Burials having a grave covering of stone cairns, found with the body interred in the vertical flexed position and stones placed on, around and below the deceased are key attributes of pastoralist (Hottentot) mortuary practices, and are considered to be independent of the age of deceased. This form of mortuary practice is not found in cave locations, as it is probable that pastoralists did not dispose of their dead in these localities.

Possibly, the agriculturalists can be accommodated within the pastoralist burial pattern. It is not possible to distinguish agriculturalist burials from the available samples, as pastoralist and agriculturalist mortuary patterns appear too alike to be separated until more evidence is produced. Thus burials belonging to group 2 are considered to be of pastoralist origin.

From this analysis it is now possible to group the remaining skeletons into pastoralist or hunter-gatherer groups (Table XXIII). These remaining burials are grouped according to the key variables recorded (body position, burial covering, etc.) with each individual burial; some skeletons analysed do not show sufficient information to be grouped and are termed 'unknowns'.

From the cultural identification of mortuary practices it is possible to amend certain dates referring to pastoralists (Table XX). The earliest evidence for pastoralism in the

Eastern Cape is a radio-carbon date associated with sheep remains of 1190 ± 100 years B.P. (SR-82) (Deacon & Deacon 1963; H.J. Deacon 1967; Klein & Scott 1974). The early appearance of sheep suggests that the earliest appearance of pastoralists occurred in the Eastern Cape from approximately 1000 years B.P. The pastoralist burials in this analysis can be said to be younger than 1000 years B.P. The remaining burials in Table XXIII are hunter-gatherers, spanning a time range of 8000 to less than 3000 years B.P.; these dates remain unchanged.

By using a non-parametric statistical test key attributes of mortuary practices of Eastern Cape Holocene hunter-gatherers and pastoralists are identified. These attributes are used to group the burial sample into different socio-cultural groups, which is tested against the dietary information gained from ^{13}C analysis in chapters VI and VII.

CHAPTER VI
LABORATORY PROCEDURE AND RESULTS
THE SKELETAL SAMPLE

In chapter V the burials used in this analysis were grouped according to key variables relating individuals by burial pattern to the categories 'hunter-gatherers' and 'pastoralists'. Of the total sample listed in Appendix A, 67 individuals were chosen for isotopic analysis. Of these, 39 individuals show a hunter-gatherer mode of burial and 17 a pastoralist burial pattern. In addition, 4 individuals from a mass grave were chosen as well as 7 individuals designated 'unknowns'.

LABORATORY PROCEDURE

Sample preparation.

Samples for ^{13}C analysis were pre-treated according to proven methods (Vogel & Waterbolk 1963). Bone samples are placed in a weak solution of hydrochloric acid (1 to 5%), and then washed in an ultrasonic cleaning bath to remove all large particles of grit, sand, etc. To extract inorganic constituents, the bone samples are placed in beakers containing hydrochloric acid (1 to 5% solution), where they are decalcified. The acid solution is changed every four days.

When the solution is no longer discoloured by the bone sample, decalcification is complete. The organic residue (collagen) is placed in distilled water, changed daily, until the pH of the residue is neutral, after which the collagen is freeze-dried and

stored in an air-tight container to prevent hydration. The preparation stage may take 1 to 2 months to complete.

Combustion.

Combustion is performed in a closed system (Figure 12) (Plate II a b c) (Schiegl & Vogel 1970). The combustion loop consists of a vertical tube with Cu-oxide at 740°C, and a horizontal quartz glass combustion tube. The oven is connected to a cooling trap which in turn is connected to the combustion tube by means of a three-way stopcock.

The pre-treated sample (0.1gm) is placed in a quartz-glass sleeve in the combustion tube. The system is evacuated and filled with 400 mm of dried oxygen. The sample is then heated until combustion is completed. The copper oxide oven is kept at approximately 740°C and the sample gases are allowed to circulate for approximately 3 hours to convert incompletely oxidized products into carbon dioxide and water. The water is then removed, using a mixture of acetone and dry ice, and the carbon dioxide sample is transferred to the copper loop for purification.

CO₂ Purification.

The copper loop shown in Figure 12 consists of a vertical tube filled with Cu and with plugs of silver thread at both ends (Plate III). This tube is maintained at a temperature of approximately 560°C., and is connected to a glass tube and a cooling trap to form a closed system.

FIGURE 12

Diagram of the combustion and purification system used to extract CO₂ from human collagen.

FIGURE 12

A schematic diagram of a laboratory apparatus for the reduction of metal oxides. The setup includes a sample (A) heated by a burner, a CuO oven (B), a glass cap (D), a Cu oven (E), a trap (C), and a sample ampule (F). The apparatus is connected by a network of glass tubes with stopcocks for flow control.

A	Sample	D	Glass cap
B	CuO Oven	E	Cu Oven
C	Trap	F	Sample ampule

D Glass cap

E Cu Oven

F Sample ampule

PLATE IIa

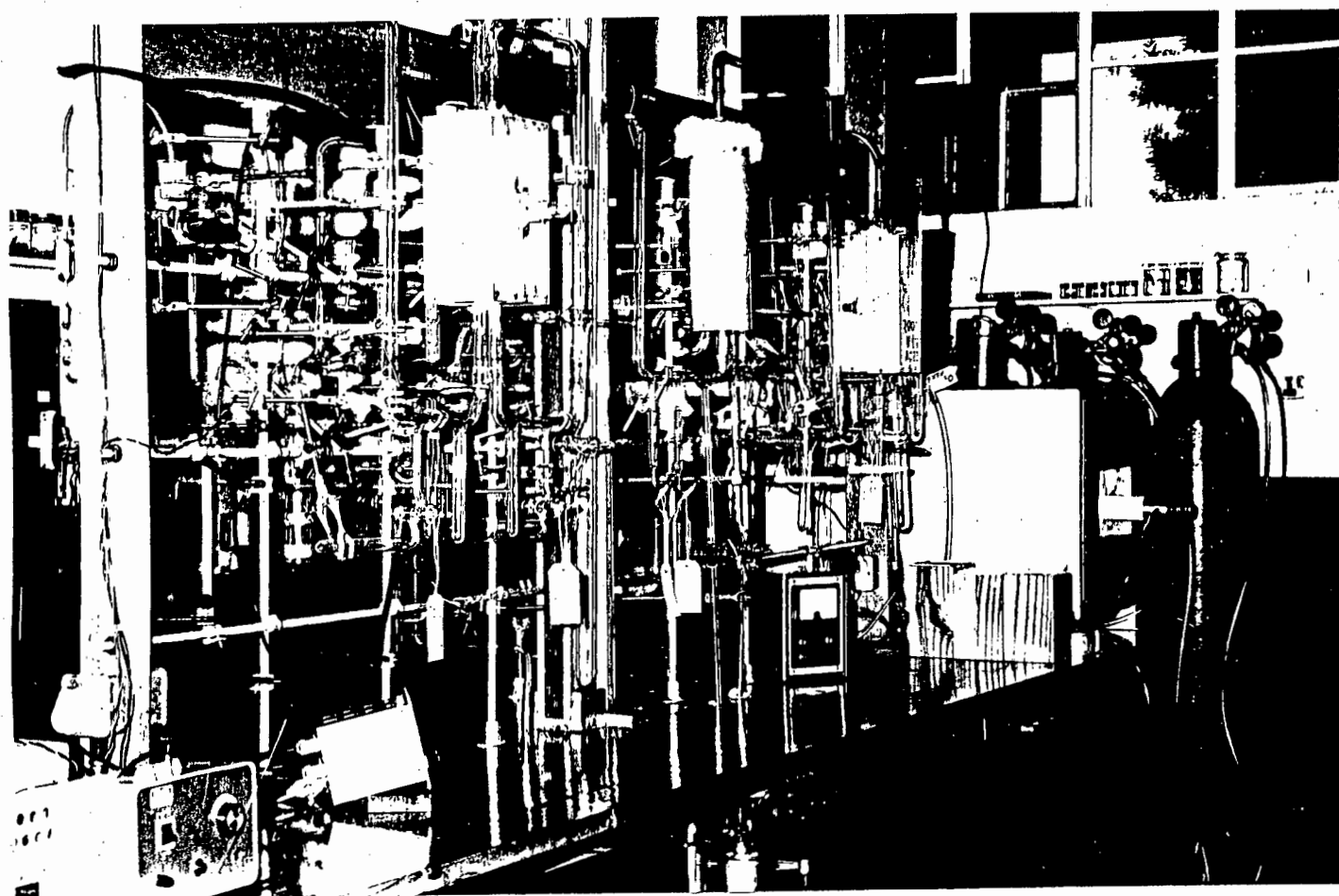
A general view of the CO₂ extraction apparatus used in the processing of samples for ¹³C analysis (Archaeometry Laboratory, U.C.T.)

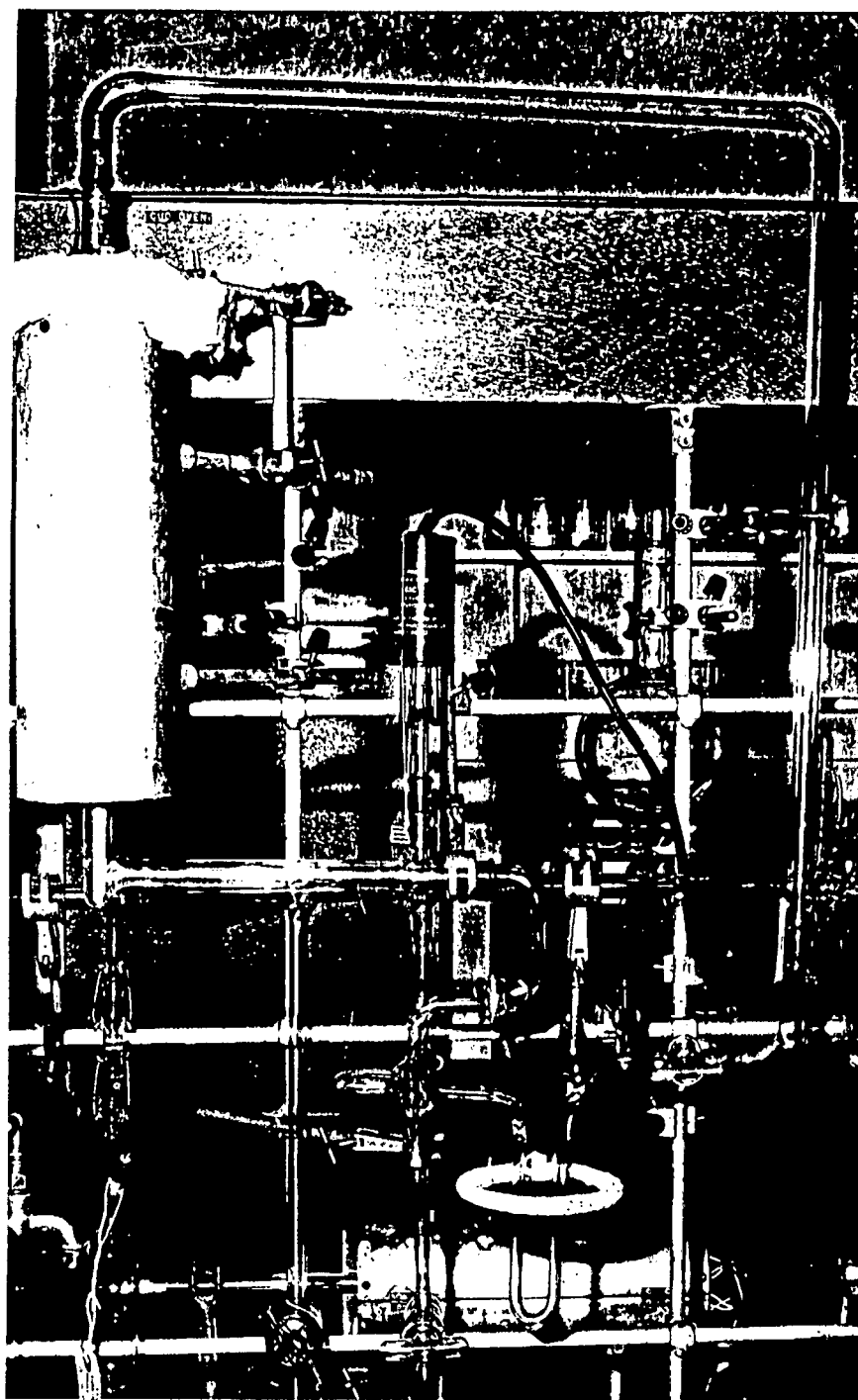
PLATE IIb

A detailed view of the combustion loop, or CuO loop used for the combustion and purification of samples for ¹³C analysis. (Archaeometry Laboratory, U.C.T.)

PLATE IIc

A detailed view of the vacuum pumps attached to the system. The mercury diffusion pump is on the left, and the rotary backing pump on the right. (Archaeometry Laboratory, U.C.T.)





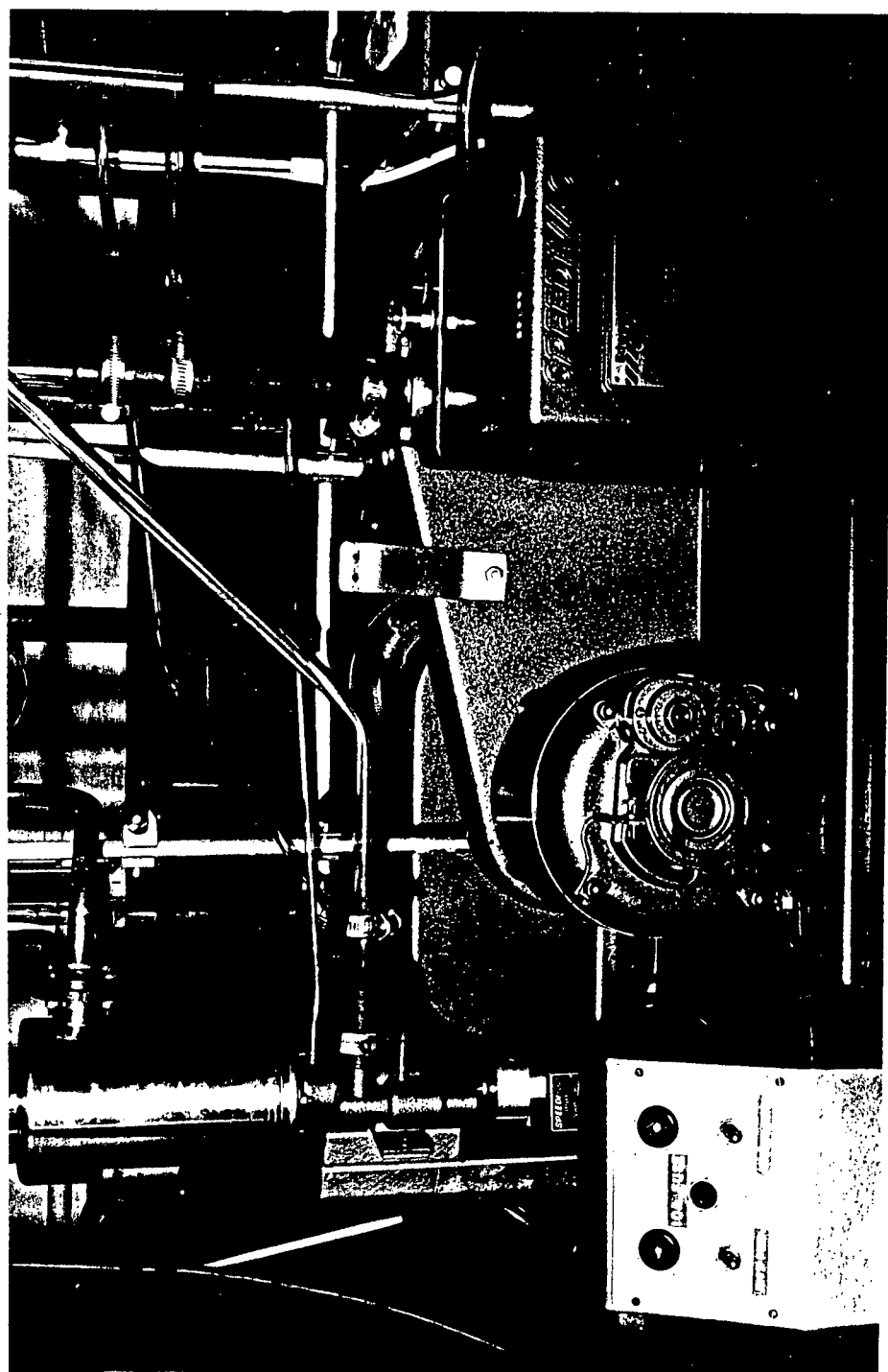
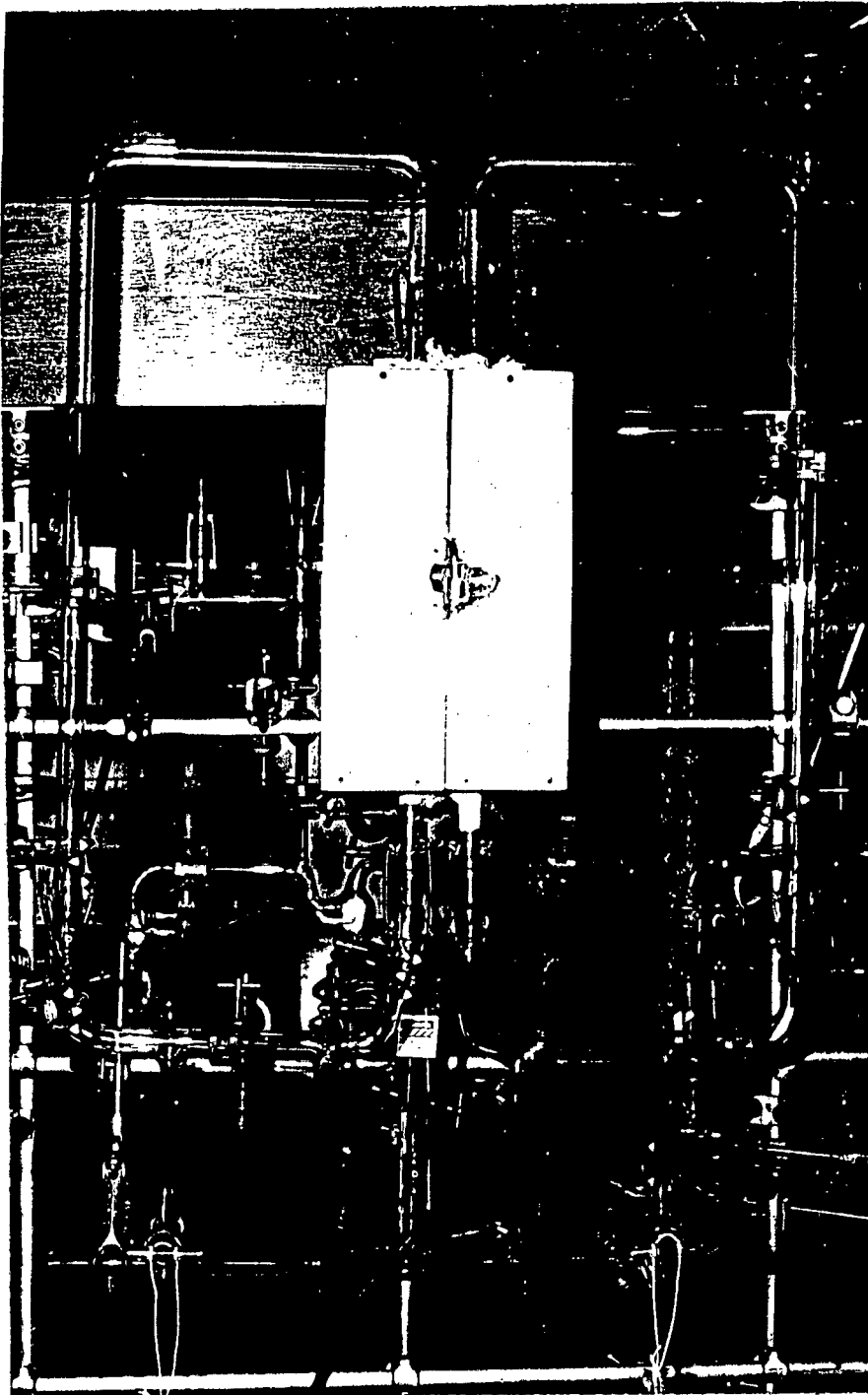


PLATE III

A detailed view of the Cu loop, which is used to remove contaminants such as nitrous oxide.

(Archaeometry Laboratory. U.C.T.)



After evacuating the copper loop, the carbon dioxide sample is trapped in it and allowed to circulate for about 24 hours. Contaminants such as nitrous oxide are reduced by the hot copper. The sample is then frozen in the cooling trap, and the nitrogen gas pumped off. After further treatment for the removal of water, the sample is transferred to an ampule attached to the pumping line (Figure 12).

Mass spectrometric measurements.

The Varian GD150 mass spectrometer of the C.S.I.R. Radiocarbon Laboratory used in this study is a 60° section double-collector instrument with improvements described by Mc Kinney et al (1950). The relative ^{13}C content ($\delta^{13}\text{C}$) is expressed as parts per thousand (per mil) deviation from the $^{13}\text{C}/^{12}\text{C}$ ratio of a selected standard material.

$$\delta^{13}\text{C} = \frac{(^{13}\text{C}/^{12}\text{C})_{\text{sample}} - (^{13}\text{C}/^{12}\text{C})_{\text{standard}}}{(^{13}\text{C}/^{12}\text{C})_{\text{standard}}} \times 1000$$

Samples enriched in ^{13}C relative to the standard will have positive values whereas samples depleted in ^{13}C relative to the standard will have negative values. All $\delta^{13}\text{C}$ values reported in this study have been related to the PDB marine limestone standard (Craig 1957) through the secondary standard used by the C.S.I.R. All $\delta^{13}\text{C}$ values quoted have standard errors of $\pm 0.2/\text{mil}$.

RESULTS

Individual $\delta^{13}\text{C}$ readings for each skeleton are given in Table XXIV. The $\delta^{13}\text{C}$ values of the 67 individuals analysed are shown in a histogram (Figure 13; Table XXIV). The sample has a mean $\delta^{13}\text{C}$ value of -12.2/mil (r: -7.8 to -16.9/mil). The pastoralist sample has a mean isotope value of -10.6/mil (r: -7.8 to -14.8/mil), and the hunter-gatherer sample a mean of -12.9/mil (r: -9.2 to -16.9/mil).

In Figure 14, the carbon isotope values are ranked from the most depleted (-16.9/mil), to the most enriched $\delta^{13}\text{C}$ value (-7.8/mil). In this figure three breaks occur. The first lies between -9.2 and -10.0/mil ($d = 0.8/\text{mil}$), the second between -11.4 and -11.9/mil ($d = 0.5/\text{mil}$), and a third between -15.7 and -16.9/mil ($d = 0.7/\text{mil}$). The sample is divided into four groups (Table XXV), situated between these breaks.

Group 1 (Table XXV) is represented by eleven individuals with a mean $\delta^{13}\text{C}$ value of -8.4/mil (r: -7.8 to -9.2/mil).

Pastoralists dominate, with two 'unknowns' and one hunter-gatherer burial. The three pastoralist children in this group are enriched in ^{13}C with respect to the adults ($d = 0.7/\text{mil}$), and the pastoralists when combined have a mean isotope value of -8.3/mil (r: -7.8 to -9.2/mil).

In group 2, thirteen individuals, represented by four pastoralists, five hunter-gatherers and four 'unknowns', have a mean $\delta^{13}\text{C}$ value of -10.8/mil (r: -10.0 to -11.4/mil) (Table XXV). The mean isotope value for the pastoralists in this group is

FIGURE 13

Histogram showing the ^{13}C values of pastoralists, hunter-gatherers and 'unknowns' analyzed in this study. Pastoralists are indicated by shaded squares, 'unknowns' are indicated by crossed squares and hunter-gatherers blank squares.

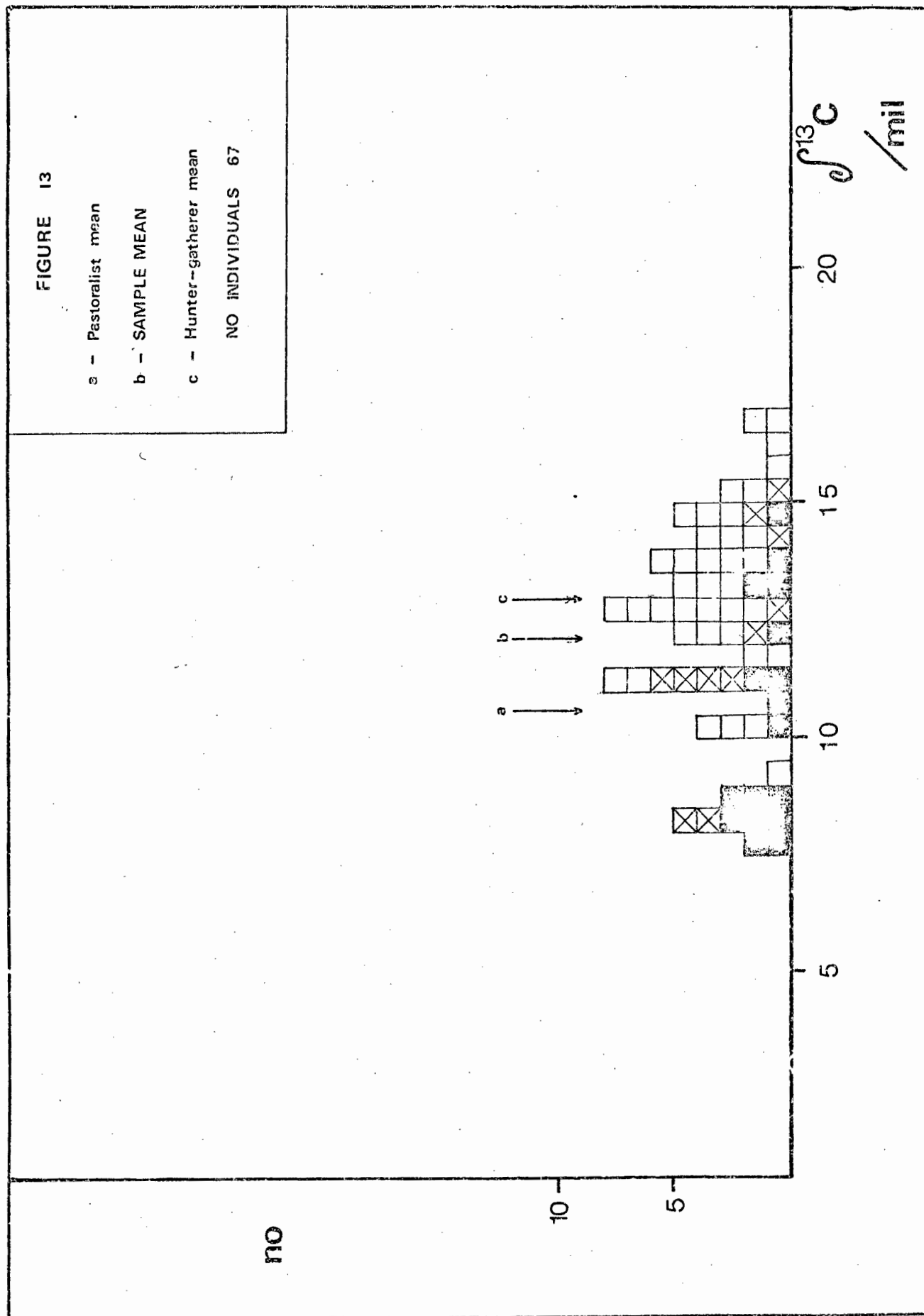
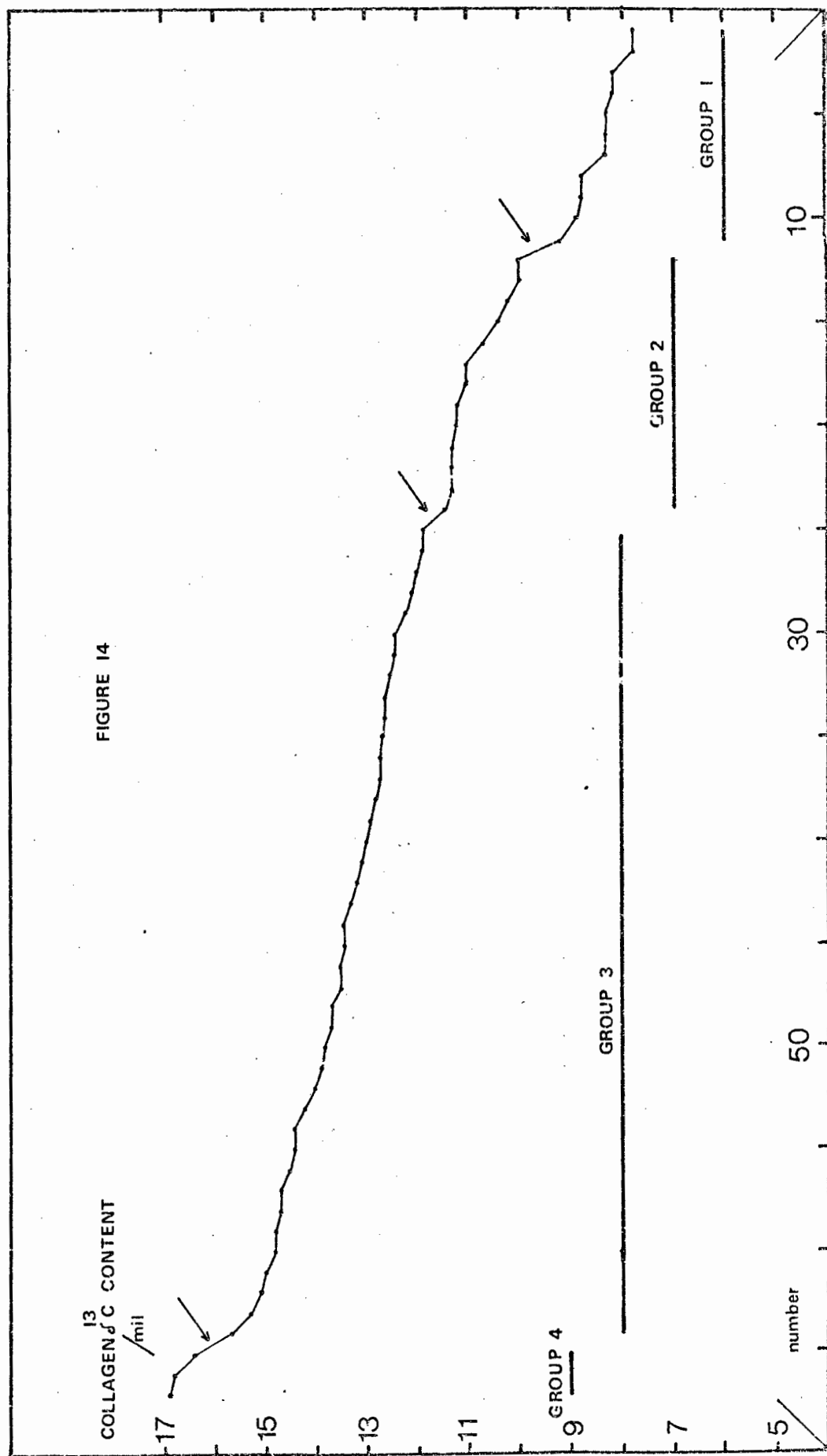


FIGURE 14

Diagram listing the ^{13}C values obtained from the most positive to most negative. Breaks where the sample was divided are shown.



-10.7/mil (r: -10.0 to -11.2/mil), and for the hunter-gatherers it is -10.5/mil (r: -10.0 to -11.3/mil). The children are found to be depleted by 0.14/mil relative to the adults.

Group 3 (Table XXV) includes 30 hunter-gatherers, five pastoralists and five 'unknowns', with a group mean of -13.4/mil (r: -11.9 to -15.7/mil). The hunter-gatherers have a mean $\delta^{13}\text{C}$ content of -13.43/mil (r: -11.9 to -15.7/mil), and the pastoralists -13.48/mil (r: -12.4 to 11.8/mil). Children are enriched by 0.43/mil relative to the adult and juvenile sample.

Group 4 (Table XXV) is represented by three hunter-gatherers, who have a mean $\delta^{13}\text{C}$ value of -16.7/mil (r: -16.4 to -16.9/mil).

DIETARY INTERPRETATION OF RESULTS

Interpretations of the carbon isotope values on human skeletal material are presented in light of the expected $\delta^{13}\text{C}$ values for Holocene populations in the Eastern Cape (Chapter IV). Estimates of the percentage contribution of various dietary staples are based on mean $\delta^{13}\text{C}$ values for C_3 plants (-26.5/mil), mixed feeders (-14.8/mil), browsing animals (-26.5/mil). (Chapter III). Percentage estimates of the isotopic contributions of various foods have an error of $\pm 10\%$.

Four groups demarcated in this section are examined separately under the headings hunter-gatherers and pastoralists (as

determined by burial type). From each group the adults and children are subsequently examined separately to determine whether the dietary habits of children and adults differ significantly.

Hunter-gatherers.

(a) Group 4.

This sample is represented by three individuals (Table XXV), two of which have radiometric age determinations of 8260^{+720} and 7300^{+200} years B.P. (H.J. Deacon 1976; J. Deacon 1972). The dated skeletons are thought to represent individuals from the early Wilton (Appendix A), and it is assumed that these three individuals are associated with the Formative Wilton.

The sample mean is $-16.7/\text{mil}$ (Table XXV), which is close to the expected $\int^{13}\text{C}$ value predicted on the basis of archaeological evidence for Formative, Developed and Climax Wilton populations ($-16.9/\text{mil}$) (Table XVI). From Table XVI, the overall importance of ^{13}C enriched foods is estimated to be approximately 36% (marine: 30%; mixed feeders: 6%), and C_3 derived foods approximately 64% (browsing animals: 15%; C_3 plant foods: 49%). If, however, no C_4 grasses were present in the Eastern Cape at this time, the mixed feeder component would be incorporated into the C_3 derived foods and thus marine foods would represent approximately 40% of the overall diet.

A further possibility (unlikely) is that C_4 grasses were present at this time in the Eastern Cape, and the sample represents

individuals who did not consume marine foods, thus allowing for an approximate 40% mixed feeding component in the overall diet.

(b) Group 3.

Thirty hunter-gatherers are represented in this sample, and two individuals have ^{14}C dates of approximately 5000 and 3000 years B.P. The $\int^{13}\text{C}$ values of the dated skeletons are -13.2 and -13.4/mil respectively, of which the older individual falls on the mean $\int^{13}\text{C}$ value for group 3 (-13.4/mil). The group 3 sample is thought to include both Climax and Post-climax Wilton individuals. The expected $\int^{13}\text{C}$ values (Tables XVI & XVII) of -16.9/mil for Climax and -14.6/mil for Post-climax Wilton populations do not conform to the group 3 mean of -13.4/mil, which shows a further ^{13}C enrichment above the expected values for both Climax and Post-climax Wilton populations. To explain the above discrepancy further percentage combinations are offered (Table XXVI).

In Table XXVIa, the mixed feeder component is increased to 70% (30% are browsers) of the overall animal diet, while the contribution of overall plants, animals and marine foods remains the same. The resultant overall $\int^{13}\text{C}$ value is -15.8/mil, which is depleted in ^{13}C relative to the mean value of -13.4/mil for group 3. Obviously, an increase in the mixed feeder component in the animal diet will not account for the discrepancy. In Table XXVIb, the intake of marine food is increased to 60% of the overall diet. The $\int^{13}\text{C}$ value of -13.5/mil obtained from this combination is close to the mean for group 3. A

further combination is suggested by increasing the mixed feeder component not only in the overall animal diet, but also increasing the overall animal food component at the expense of C_3 plant foods in the terrestrial diet to 60%. Marine foods are decreased to 40% of the overall diet. The resultant $\delta^{13}C$ value of -13.8/mil is close to the mean of group 3. (Table XXVIc).

These additional combinations show that, in order to obtain the mean $\delta^{13}C$ value of group 3, the overall ^{13}C enriched food component (mixed feeders ; marine foods) must be increased to approximately 60% in combination with 40% C_3 derived foods (browsers, C_3 plants) in the overall human diet.

Further possibilities occur, however, which can account for the mean $\delta^{13}C$ value of -13.4/mil obtained for group 3. If no C_4 grasses were present in this region during the Climax and Post-climax Wilton, the ^{13}C enriched component of approximately 60% would represent only marine foods. Conversely, if the hunter-gatherers in group 3 represent a population who did not consume marine foods, one would expect the ^{13}C enriched food component of approximately 60% to represent only mixed feeders, thus allowing for the presence of C_4 grasses in the Eastern Cape. The second possibility is unlikely, as it is known that Wilton populations consumed marine foods. The first possibility is also unlikely, as marine foods, although an important food source, are not expected to have been the principal food source in Wilton hunter-gatherer diets.

The most depleted $\delta^{13}C$ value of -15.7/mil in group 3 shows an

overall ^{13}C enriched food component of approximately 44% and C_3 derived component of approximately 56%. This suggests a dietary combination closer to that of group 4 than 3. It is possible that this isotope value is representative of an individual in transition between group 4 and 3, and if so is possibly older than 5000 years B.P.

The most enriched value of -11.9/mil in group 3 may represent a hunter-gatherer whose mixed feeding dietary component is high, and whose overall animal dietary component is increased at the expense of C_3 derived foods. Marine foods are possibly as important as terrestrial foods in the overall diet. The overall ^{13}C enriched food component is approximately 78% and C_3 derived foods 22%. Individuals found in this ^{13}C range would be examples of hunter-gatherers who have retained the traditional economic practices such as the collection of bulbs, hunting small game, and the collection of marine foods, but had acquired in addition domestic stock such as sheep and cattle from pastoralists.

(c) Group 2.

Group 2 is made up of five hunter-gatherers whose mean $\delta^{13}\text{C}$ value is -10.5/mil. This isotope value gives an overall estimate of ^{13}C enriched foods to be approximately 87% and C_3 derived foods 13%. To account for this value, both marine foods and mixed feeders would have to be increased substantially at the expense of C_3 derived foods. Alternatively, the observed enrichment may be due to the inclusion of domestic C_4 plants at the expense of C_3 plants. The second alternative would also

account for the enrichment of 0.5/mil of hunter-gatherers in group 2 relative to the group 3 sample, as it is not expected that a higher contribution of marine and mixed feeders in the diet will result in the break in isotope values between these two groups. It is therefore suggested that the observed differences between group 3 and group 2 are accounted for by the inclusion of a new food resource in the overall diet, namely domesticated plants.

(d) Group 1.

One infant hunter-gatherer is represented in this group, with a $\delta^{13}\text{C}$ value of -9.2/mil. As this individual was still suckling at time of death, no other explanation can be offered to account for its high intake of ^{13}C enriched foods except possibly milk from a mother whose diet included a high contribution of ^{13}C enriched foods. The isotopic fractionation effect in mother's milk is unknown.

Hunter-gatherer adults and children.

A separate examination of adults and children in group 3 is undertaken to determine whether dietary patterns differ due to age and possibly sex. Individuals from groups 1, 2 and 4 are not considered as they are too small in number to afford meaningful interpretations.

(a) Group 3.

The adults show a mean $\delta^{13}\text{C}$ content of -13.3/mil (r:-11.9 to -15.7/mil), and the children are found to be depleted relative

to the adults and have a mean $\delta^{13}\text{C}$ value of -13.6/mil (r: -12.7 to -15.1/mil) (Table XXV). The range of the child sample is smaller and no children are present between the $\delta^{13}\text{C}$ ranges of -11.9 to -12.7/mil, and -15.1 to -15.7/mil.

The presence of adults, mostly males, in the range of -11.9 to -12.7/mil suggests a preferential intake of more ^{13}C enriched foods by these adults. The dietary combination of Table XXVId, if applied to these adult hunter-gatherers, would suggest that these males are consuming greater quantities of meat from domestic stock such as sheep and cattle. Two adults are more depleted in ^{13}C than the most depleted child (-15.1/mil) but these individuals may represent hunter-gatherers from an earlier time period, therefore negating an interpretation of preferential dietary intake in this instant.

Since the group 3 sample represents hunter-gatherers which span both the Climax and Post-climax Wilton, it is difficult to offer explanations for dietary differences between adults and children without strict chronological control.

Pastoralists and Agriculturalists.

Seventeen individuals identified as pastoralists on the grounds of mortuary practices (Chapter V) were analysed; on available radio-carbon evidence they are believed to have lived in the Eastern Cape during the last 1200 years B.P.

Two possible dietary combinations are proposed in chapter IV, both of which may give $\delta^{13}\text{C}$ values expected for pastoralists and agriculturalists. From the archaeological, historical and

ethnological record, the diet of a pastoralist is expected to include a high proportion of food derived from sheep and cattle, subsidiary foods from C_3 plants and browsing animals, and some marine foods. The agriculturalist diet is expected to include a high proportion of C_4 domesticated plants, plus mixed feeders such as sheep and cattle (Table XIX). The expected $\delta^{13}C$ values obtained are compared with the carbon isotope values obtained on human skeletal material from the Eastern Cape. The isotope readings are interpreted separately within groups 1, 2 and 3.

(a) Group 3.

Five pastoralists in this group show a mean $\delta^{13}C$ value of -13.4/mil (r: -12.4 to -14.8/mil), a result close to the predicted $\delta^{13}C$ value of -13.6/mil for pastoralists (Table XXV).

The overall contribution of ^{13}C enriched foods in this group is similar to that of the hunter-gatherers in group 3. Estimates for mixed feeders and marine foods are approximately 64% and C_3 derived foods 36%. The 64% estimated for the contribution of ^{13}C enriched foods is expected to include primarily mixed feeders, which dominate the overall diet. Both browsers and C_3 plants are expected to make up the remaining 36% of the overall diet.

(b) Group 2.

The three individuals in this sample have a mean $\delta^{13}C$ value of -10.7/mil, and show a further enrichment in ^{13}C with respect to the pastoralists in group 3. Up to approximately 87% of the

overall diet is made up of ^{13}C enriched foods and the remaining 13% C_3 derived foods (Table XXVII). It is proposed that these pastoralists with a normal intake of a high proportion of sheep and cattle (mixed feeders), but who have acquired small quantities of C_4 domesticated crops in their diet at the expense of C_3 plants. (Table XXVII). The pastoralists in this group would thus appear to be in transition between pastoralism and agriculture.

(c) Group 1.

Eight individuals showing a pastoralist burial pattern are represented in this group. The mean $\delta^{13}\text{C}$ value for these individuals is -8.3/mil, which is close to the expected $\delta^{13}\text{C}$ value of -9.8/mil (Table XIX) for agriculturalists. The mean $\delta^{13}\text{C}$ value obtained for this group shows that up to 96% of the overall diet includes ^{13}C enriched foods, presumably C_4 domesticates and mixed feeders. In the total animal contribution to the diet it is estimated that mixed feeders such as sheep and cattle contribute approximately 90%, and in the terrestrial diet C_4 domesticates 60%.

Pastoralist/Agriculturalist adults and children.

In group 1 only two children are present, from the same site. Both show a further enrichment of 0.7/mil relative to the adults in the group. As these children are old enough to have been weaned, their further ^{13}C enrichment can be said to be a result of a high consumption of C_4 domesticates (approximately 80%), and supplemented with milk from domestic animals (approximately 13%).

Too few individuals are represented in group 3 to enable differences in adult and child diets to be detected.

'Unknowns'.

In group 1 two individuals (Table XXV) show $\delta^{13}\text{C}$ values close to the mean for group 1 (-8.3/mil), and are considered to be agriculturalists.

Four individuals in group 2 have been identified, of which two children (1088;112B) belong to the same 'family group' represented by two adults in group 3 (109B; 111B). The children show an enrichment in ^{13}C of 1.1/mil relative to the adults from the same family group. The adults in group 3 show approximately 65% mixed feeder component (sheep and cattle, and a 35% C_3 derived food component (browsers and C_3 plants). The two children show that up to 80% of their diet is derived from ^{13}C enriched foods, the remainder from C_3 derived foods; this suggests that if these children were weanlings, up to 80% of their diet was derived from ^{13}C enriched foods, presumably milk from sheep and cattle. If this interpretation is accepted, then this family group can be considered to be pastoralists.

The other 'unknowns' in group 2 and 3 are difficult to place as they could be either hunter-gatherers or pastoralists, which would allow for different interpretations of the carbon isotope contents. In order to obtain any meaningful interpretation on these individuals a radio-carbon date would be required as these individuals have no cultural association.

CHAPTER VII

DISCUSSION AND CONCLUSIONS

SUMMARY OF RESULTS

Collagen from 67 skeletons of the Holocene of the Eastern Cape were analysed for their relative ^{13}C content in this study. The individual skeletons were divided into groups on the basis of a cultural attribute (mode of burial) and diet (through ^{13}C determinations). The burial analysis (Chapter V) provides a means whereby the majority of skeletons are designated as either hunter-gatherers or pastoralists. In the historical record, these categories are synonymous with Bushmen and Hottentots. The carbon isotope study allows for a division of the skeletons into four groups which have dietary implications. Some preliminary anatomical assessments of the skeletons also allow for a Khoisan/Negro division to be made. It is obvious from the results that the composite categories Bushmen/hunter-gatherers, Hottentot/pastoralists and Negro/Iron Age/agriculturalists do not hold in all cases. This is yet another illustration of the well-known Boasian maxim that race, language and culture (and diet, for that matter) are not covariant.

~~Another~~

Another noticeable feature of this analysis is that conclusions about diet based on previous archaeological investigations in the region are not always borne out by ^{13}C measurements. This gives rise to the situation where expected changes in economy or diet are not observed isotopically, while in other instances the opposite occurs. These differences between expected and observed results are viewed in the light of possible

environmental changes within the Holocene, and in sampling bias introduced into the archaeological results due to emphasis on cave excavations. From the results reported in this thesis, the following points are made about hunter-gatherer and pastoralist diet in the Eastern Cape.

Isotope Group 4 (n=3; r: -16.4 to -16.9/mil; mean = -16.7/mil)

Stable carbon isotope determinations on hunter-gatherers believed to be associated with the Formative Wilton (circa 7000 years B.P.) yield relative ^{13}C readings close to values postulated on the basis of archaeological evidence (expected: -16.9/mil; observed: -16.7/mil). These individuals reveal a dietary intake of approximately 60% C_3 derived foods (browsing antelope; C_3 plant foods) and 40% ^{13}C enriched foods (mixed feeding ungulates; marine foods).

Isotope Group 3 (n=40; r: -11.9 to -15.7/mil; mean = -13.4/mil).

Climax and post-Climax Wilton populations (circa 5500 to 2000 years B.P.) contrast with those of the Formative Wilton in ^{13}C composition. C_3 derived foods account for approximately 40% of the overall diet (down from 60%) and ^{13}C enriched foods comprise approximately 60% (up from 40%). These isotopic assessments of the diet composition of later Wilton populations differ substantially from ^{13}C values (expected: -16.9/mil; observed: -13.4/mil) based on archaeological evidence. Diets of the Formative and Climax Wilton, archaeologically determined to be roughly the same, turn out to be substantially different. In

further contrast to archaeological conclusions, little difference is noted in the ^{13}C composition of Climax and post-Climax Wilton hunter-gatherers. The dietary differences which have been suggested on the basis of the archaeological record in this case include the exploitation in the post-Climax Wilton of fresh water mussel (Cafferia caffer), the appearance of storage pits and the possibility of an increase in the exploitation of marine resources.

Included in isotope group 3 are individuals identified as pastoralists on the basis of their mode of burial while their isotope composition (expected: -13.6/mil; observed: -13.4/mil), is similar to that of hunter-gatherers from the same group; their diet can be explained in a different manner. Of their overall diet, 60% is derived from ^{13}C enriched foods, presumably mixed feeders (sheep and cattle), and 40% is provided by C_3 derived foods (browsing antelope and C_3 plant foods). These isotopic assessments of diet composition accord with predicted values for pastoralists who were not in contact with agriculturalists.

Isotope Group 2 (n=13; r: -10.0 to 11.4/mil; mean -10.8/mil)

Some individuals identified as hunter-gatherers on the basis of burial pattern show an additional inclusion of ^{13}C enriched food in their diet when compared to isotope group 3. This addition is most economically explained as a C_4 domestic crop, suggesting that these individuals were in transition between hunting and gathering and agriculture. A similar pattern is observed in the pastoralists in the same group, and it can be suggested that these individuals

are similarly in transition between pastoralism and agriculture.

Isotope Group 1 (n=11; range -7.8 to -9.2/mil; mean = -8.4/mil)

This group includes individuals identified as pastoralists from burial pattern, but who show a particularly high intake of ^{13}C enriched foods: mixed feeders (sheep and cattle) and C_4 domesticated plants (sorghum, millet and maize). On the basis of the ^{13}C values and consequent dietary interpretations, these individuals can be considered agriculturalists. The skeletons from the site Kleinpoort which are included in this group (Table XXV) have been provisionally identified on anatomical grounds as Khoisan with Negro admixture (Morris pers. comm.). Coupled with their geographical location (along the Fish River) and historical reports, it is suggested that these individuals belong to the pastoralist group Gonoqua - who were known to be in contact with Negro agriculturalists living on the other side of the Great Fish River (Hewitt 1920).

Children

Several skeletons of children were included in the analysis. Although the sample is small, it is noticeable that they have ^{13}C values which are more positive than those for adults in their respective groups. Their diet, in other words, included more ^{13}C enriched foods. This is the case for two pastoralist/agriculturalist children in isotope group 1. A similar situation is found among pastoralist children in group 2, relative to adults from the same family in group 3. Not enough is known about the fractionation of ^{13}C in mothers milk to draw firm conclusions

about this phenomenon. It can be suggested, however, that the diets of these children were concentrated on such items as milk from mixed feeders in the case of children from group 2, and a high consumption of porridge made from C_4 plants in the case of the children in group 1.

DISCUSSION

While most of the results reported here bear out archaeological expectations, an unexpected situation was found in the observed dietary difference between individuals of the early Wilton (Formative-Developed), and the later Wilton (Climax - post-Climax). Alternative explanations for these results involve a major change in environment, a change in subsistence behaviour or a combination of both.

Isotope results for early Wilton individuals (isotope group 4) have been interpreted as including approximately 60% C_3 derived foods, and 40% ^{13}C enriched foods. Later Wilton individuals, on the other hand, have the exact opposite dietary combination (40% C_3 derived foods; 60% ^{13}C enriched foods). The most economic explanation of this change involves a change in environment which led to a different subsistence strategy. Butzer & Helgren (1972) suggest a period of temporary forest advance at about 7000 years B.P., which would provide a situation in which C_4 grasses are uncommon or entirely absent. If entirely absent, the early Wilton diet can only be explained as consisting of 40% marine foods and 60% C_3 derived foods. The mixed feeders, if present in the early Wilton diet, would be in this instance included in the C_3 derived food component. If there were at least some C_4

grasses available, however, a somewhat more reasonable explanation arises, namely that 40% of the overall early Wilton diet included both marine and mixed feeders. This explanation seems to accord better with archaeological explanations, but it must be stressed that traditional archaeological methods do not allow for definite quantitative statements about overall prehistoric diet.

The observed increase from approximately 40% to 60% in the ^{13}C enriched food component between early and later Wilton individuals must be explained as an increase in marine exploitation or an increase in the hunting of mixed feeders, or a combination of both. If no major environmental change took place during this time, it would be hard to credit a major increase in the hunting of mixed feeders, in which case a considerable increase in marine exploitation would be the only explanation. If, on the other hand, there was a considerable change in environment, yielding open coastal grasslands in place of forest/bush environments, a more natural explanation seems possible. Under such conditions, animal populations on the coastal grasslands would have included grazing herd animals in place of solitary browsing ungulates. The presence of herds of grazing ungulates would have formed a powerful attraction to hunter-gatherers, resulting in increased interest in hunting in the coastal regions. Increased marine exploitation could also have resulted due to the close proximity of the coast to the hunting area. This explanation is considered preferable to the alternative, which involves a major change in subsistence strategy due to non-environmental factors, such as the arrival of a different group of people.

The preferred explanation makes provision for the increased

inclusion of mixed feeders in the diet of hunter-gatherers. This situation is not evident from material excavated at such cave sites as Melkhoutboom, Nelson Bay and Klasies River Mouth. At Wilton Large Rock-shelter, however, the faunal sample, although small, is dominated in species composition by grazing ungulates. Similarly, grazers are well represented at Uniondale - another cave site in the Eastern Cape. This suggests that grazing ungulates played a more important role in the diet of Wilton hunter-gatherers than previously supposed. The absence of a large mixed feeder faunal component at cave sites such as Melkhoutboom, Nelson Bay and Klasies River Mouth could be a direct result of their location in bush/forest environments - ideal conditions for small solitary browsing antelope, which dominate the faunal assemblage of these sites. To date, little attention has been paid to the study of the archaeology of open habitats which are more suited to mixed feeders; this provides yet another reason for the absence of these animals in the recorded diet of Wilton hunter-gatherers.

The second observation of major importance which flows from the isotope results is the similarity in diet of Climax and post-Climax Wilton populations. The lack of radiometric dates makes it difficult to assign individuals to one or the other phase with assurance. Even if this were possible, however, the difference in ^{13}C readings would in any case be small. The range of isotopic variation in isotope group 3 is not large enough (-11.9 to -15.7/mil) to measure changes of major proportions. All the available archaeological evidence suggests that a change should in fact be detected. A possible explanation for this apparent contradiction is that an increase in marine exploitation

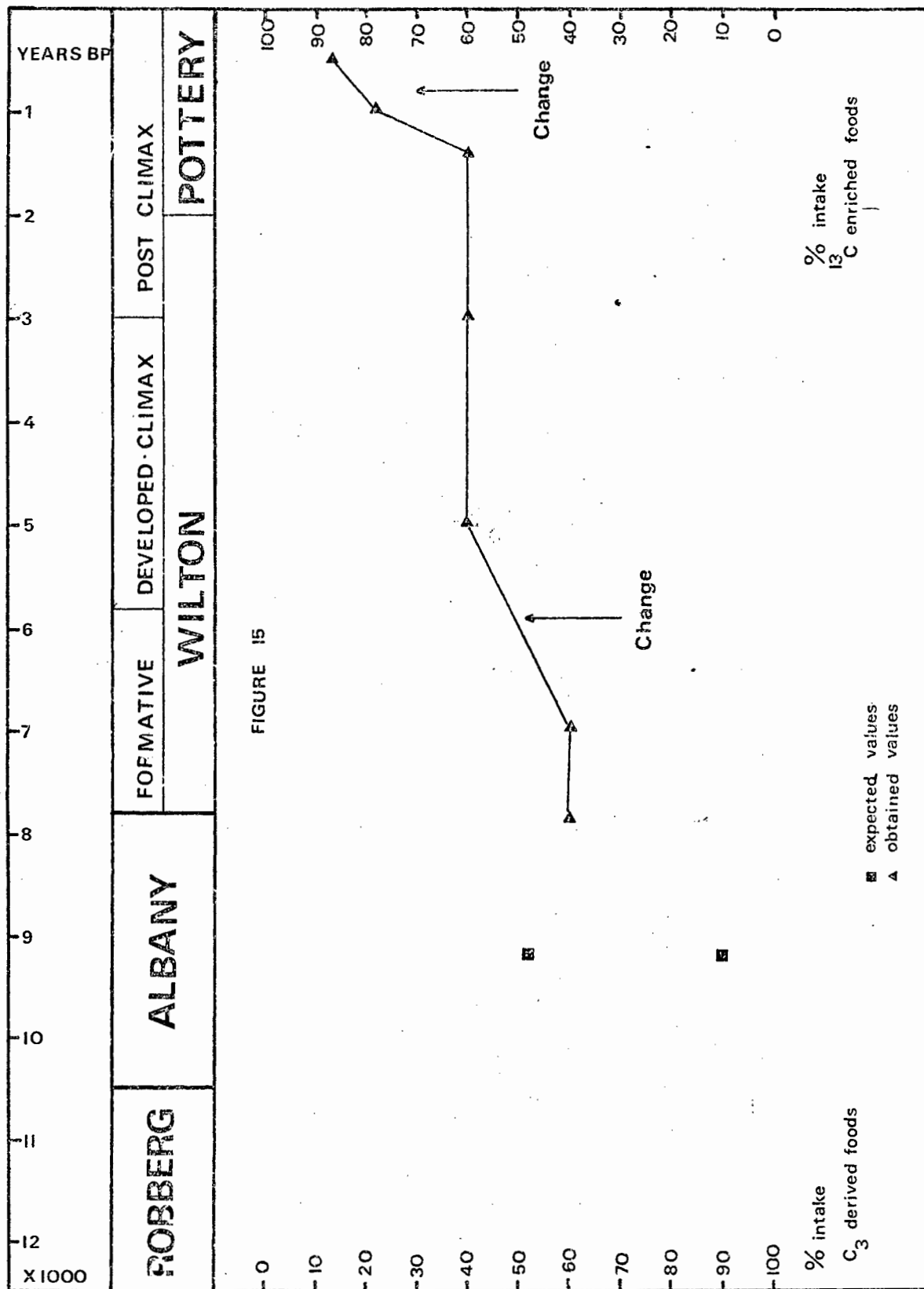
(enriched in ^{13}C) did take place, but that it was isotopically counteracted by an equal increase in exploitation of fresh water mussels (C_3 in ^{13}C content). Such an explanation is tantamount to a scientific balancing act.

A third observation of interest involves the further ^{13}C enrichment of both pastoralists and hunter-gatherers in isotope group 2. Individuals from this group show quite clearly the addition of a further 20% from ^{13}C enriched foods, apparently a C_4 crop. If so, these results show that both hunter-gatherers and pastoralists had access to domesticated plants. This demonstrates that Iron Age agriculturalists in the Eastern Cape were in contact with both pastoralists and hunter-gatherers. These individuals are believed to be in transition between hunter-gathering/pastoralism and total agriculture. No ^{14}C age determinations are available on any individuals from this group; such assays could establish when C_4 domesticates appeared and also whether pastoralism or agriculture was first to appear in this region.

The overall dietary shifts amongst Eastern Cape Holocene populations is shown in Figure 15. Three major dietary changes are evident: a shift in subsistence strategy between early and later Wilton populations; the advent of pastoralism; and agriculture. The introduction of pastoralism is shown as preceeding agriculture. This remains speculative until additional chronological control is obtained on pastoralists and pastoralist skeletons which show a high inclusion of domesticated crops.

FIGURE 15

Diagram showing the summary of observed trends in the overall diet from the population analysed. Major dietary shifts are indicated."



CONCLUSIONS

The results show that carbon isotope analyses of human skeletons provide a basis whereby the validity of conclusions made about prehistoric diet and subsistence from archaeological, ethnographic and historical sources can be tested. In some instances conclusions based on archaeological evidence are substantiated, but in others aspects of prehistoric diet and subsistence not recognised in the archaeological record are highlighted. Most noticeable in this regard is an obvious shift in subsistence between early and later Wilton populations. This change in subsistence has been interpreted as resulting from environmental change between two phases of the Wilton. The subsistence change involves the inclusion of a large mixed feeder element in the overall diet of the later Wilton, which is certainly not evident from major excavated cave sites in this region. This is seen as a consequence of archaeological strategy which has excluded the study of open sites.

These conclusions demonstrate the power of an analytical technique which can measure human diets directly in quantitative terms, as opposed to the indirect, qualitative methods traditionally available to archaeologists. The use of carbon isotopes as dietary tracers in humans is new in archaeology - indeed, this is the first study of its kind in Africa and one of a few anywhere. As a result, the skeletal sample and environmental data were not in all respects a match for the power of the technique. A number of factors could have increased the success of the analysis. The isotopic composition of marine and terrestrial foods in the Eastern Cape had to be postulated in many cases,

based on data from similar situations elsewhere; more empirical data from the area would have increased interpretive accuracy. In addition, better archaeological information about the burials and their associated finds, anatomical analysis of the skeletons themselves, and ^{14}C age determinations would increase the value of the ^{13}C results immensely. These observations notwithstanding, the results reported here add a new dimension to the study of human behaviour in the Eastern Cape. Its applicability to other areas are readily apparent and archaeologists will have to come to terms with it in designing research strategies.

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TABLE I

TABLE SHOWING THE FREQUENCY OF BROWSING AND MIXED FEEDING
UNGULATES FROM MELKHOUTBOOM CAVE, NELSON BAY CAVE & KLASIES
RIVER MOUTH; WILTON LARGE ROCK-SHELTER, SCOTTS CAVE AND
HIGHLANDS ROCK-SHELTER.

MELKHOUTBOOM

	10,500 to 7500 BP		7500 to 6000 BP		6000 to less than 3000 BP		3000 BP	
	RF-MBS		WBM,M,W.		MB		CAF,OMB	
	f	%	f	%	f	%	f	%
BROWSERS	11	19.2	235	70.3	50	79.3	48	82.7
MIXED FEEDERS	46	80.7	99	29.6	13	20.6	10	17.2
TOTAL	57	99.9	334	99.9	63	99.9	58	99.9

NELSON BAY CAVE & KLASIES RIVER MOUTH

	10,500 to 7900 BP		7900 to 3000 BP		3000 to <2000 BP		2000 BP	
	f	%	f	%	f	%	f	%
BROWSERS	92	47.9	138	81.6	85	76.5	66	49.6
MIXED FEEDERS	100	52.0	30	17.7	26	23.4	67	50.3
TOTAL	192	99.9	169	99.3	111	99.9	133	99.9

WILTON LARGE ROCK-SHELTER

	10,500 to 7500 BP		7500 to <3000 BP		3000 BP	
	4A to 4B		3D to 3I		1-3c	
	f	%	f	%	f	%
BROWSERS	2	28.5	2	16.6	5	31.2
MIXED FEEDERS	5	71.4	10	83.3	11	68.7
TOTAL	7	99.9	12	99.9	16	99.9

SCOTTS CAVE

	< 1000 BP	
	S,1,2,3,4	
	f	%
BROWSERS	21	52.5
MIXED FEEDERS	19	47.5
TOTAL	40	99.9

HIGHLANDS ROCK-SHELTER

	< 4500 BP	
	SS,I,II	
	f	%
BROWSERS	30	35.7
MIXED FEEDERS	54	64.2
TOTAL	84	99.9

MELKHOUTBOOM, NELSON BAY, KLASIESRIVER, WILTON,
AND SCOTTS CAVE COMBINED

	ALBANY		WILTON		POST- CLIMAX WILTON	
	f	%	f	%	f	%
BROWSERS	105	41.0	425	73.6	225	62.8
MIXED FEEDERS	151	58.9	152	26.3	133	37.1
TOTAL	256	99.9	577	99.9	358	99.9

Data from:- Klein & Scott (1974)
H.J. Deacon (1976)
Klein (1978)

TABLE II

TABLE SHOWING THE FREQUENCY OF CAFFERIA, OSTRICH EGG, ACHATINA,
DONAX AND NASSA, FROM MELKHOUTBOOM AND WILTON LARGE ROCK-
SHELTER.

MELKHOUTBOOM

		10500 to 7500 BP RF-NBS	7500 to 6000 BP WBM.M. W.	6000 to 3000 BP MB	3000 BP CAF to OMB	TOTAL
<u>Cafferia</u>	f	0	1	3	57	61
	%	0	1.6	4.9	93.4	99.9
<u>OES</u>	f	267	2816	130	114	3327
	%	8.0	84.6	3.9	3.4	99.9
<u>Achatina</u>	f	4	22	11	9	46
	%	8.6	47.8	23.9	19.5	99.8
<u>Donax</u>	f	14	53	20	7	94
	%	14.8	56.3	21.2	7.4	99.9
<u>Nassa</u>	f	9	1	0	16	26
	%	34.6	3.8	0	61.5	99.9

WILTON LARGE ROCK-SHELTER

		10500 to 7500 BP 4A-4B	7500 to 3000 BP 30-3I	3000 BP 1-3C	TOTAL
<u>Cafferia</u>	f	0	5	50	55
	%	0	9.0	90.9	99.9
<u>OES</u>	f	18	189	65	272
	%	6.6	69.4	23.8	99.8
<u>Achatina</u>	f	19	211	84	314
	%	6.0	67.1	26.7	99.9
<u>Donax</u>	f	6	169	27	202
	%	2.9	83.6	13.3	99.9
<u>Nassa</u>	f	2	0	9	11
	%	18.1	0	81.8	99.9

TABLE III

¹³C CONTENT OF PLANTS KNOWN TO FOLLOW THE CALVIN PATHWAY ¹³C CONTENT OF PLANTS KNOWN TO FOLLOW THE C₄ - DICARBOXYLIC ¹³C CONTENT OF PLANTS KNOWN TO FOLLOW THE CRASSULACEAN PHOTOSYNTHESIS (C₃ PLANTS) ACID PATHWAY OF PHOTOSYNTHESIS (C₄ PLANTS) ACID PATHWAY OF PHOTOSYNTHESIS (C₄ PLANTS) ACID METABOLISM FROM THE GENUS ALOE, SOUTH AFRICA.

calculation of the mean (\bar{x}), standard deviation (S_x) and standard error ($S_{\bar{x}}$) by the group data method.

Calculation of the mean (\bar{X}), standard deviation (S_x), and standard error ($S_{\bar{x}}$), by the group data method.

Calculation of the mean (\bar{x}), standard deviation (S_x), and standard error ($S\bar{x}$), by the group data method.

[illegible]

Data from : Vogel & Erhalt (1963).

TABLE IV

^{13}C CONTENT OF MARINE PLANKTON FROM VARIOUS LOCALITIES
SHOWING VARIATIONS IN ISOTOPE COMPOSITION AS A FUNCTION
OF WATER TEMPERATURE.

Calculation of the mean (\bar{x}), standard deviation (S_x)
and standard error of various plankton samples at
different temperatures.

Temp °C	f	\bar{x} /mil	S_x /mil	$S_{\bar{x}}$ /mil
Cold & Cool temperate 0 to 15	24	-25.68	2.66	0.54
Warm temperate 15 to 30	26	-20.78	1.65	0.32

Data from : Sackett et al (1965)
Degens et al (1968)
Deuser (1970)

^{13}C CONTENT OF MARINE ALGAE FROM VARIOUS LOCALITIES
SHOWING VARIATIONS IN THE ISOTOPE COMPOSITION AS A
FUNCTION OF TEMPERATURE.

Temp °C locality	f	\bar{x} /mil	S_x	$S_{\bar{x}}$
0 - 15 (Cold Temperate) Bornholm & Kiel, Denmark	6	23.47	5.75	2.35
15" - 30 (Warm temperate) Redfish Bay, Texas	4	15.70	2.96	1.48

Data from : Parker (1964)

^{13}C CONTENT OF MARINE MACROPHYTES FROM VARIOUS LOCALITIES
SHOWING VARIATIONS IN THE ISOTOPE COMPOSITION AS A FUNCTION
OF TEMPERATURE.

Temp. °C	f	\bar{x}	S_x	$S_{\bar{x}}$
0 - 15 (Cold temperate) Bornholm & Kiel, Denmark	5	-16.57	5.52	2.25
15 - 30 (Warm Temp) Redfish Bay, Texas	4	-9.58		

Data from : Parker (1964)
Erlenkeuser et al (1975)

TABLE V

AVERAGE SEA TEMPERATURES OF VARIOUS LOCALITIES.

SAMPLE AREA	°LATITUDE	AVERAGE SURFACE TEMP °C (Ave.)	APPROX. ANNUAL SURFACE TEMP °C (Range)
<u>COLD TEMPERATE (0-15°C)</u>			
Bornholm, Denmark	55°N	8.66	0 to 15
Kiel Bight, Denmark	55°N	8.66	0 to 15
<u>COOL TEMPERATE (10-15°C)</u>			
Elandsbay, South Africa	32°S	13.9	12 to 15
<u>WARM TEMPERATE (15-20°C)</u>			
Eastern Cape Coast, South Africa	35°S	18.0	14 to 25
Redfish Bay, Texas	30°N	24.6	20 to 30

Data from : Division of Sea Fisheries, South Africa.
McLachlan (1977)

TABLE VI

^{13}C CONTENT OF MARINE ANIMALS FROM VARIOUS LOCALITIES
SHOWING VARIATIONS IN ISOTOPE COMPOSITION AS A FUNCTION
OF WATER TEMPERATURE.

Temp °C Locality Animal	f	\bar{x} /mil	s_x /mil	$s_{\bar{x}}$ /mil
<u>MOLLUSCA</u>				
(Cold temperate) Kielbight, Denmark	5	-20.92	0.75	0.34
(Cool temperate) Elandsbay, South Africa(6)	7	-17.04	2.01	0.76
(Warm temperate) Redfish Bay, Texas	2	-21.50		
<u>CRUSTACEAE</u>				
(Warm temperate) Redfish Bay, Texas	6	-14.80	2.17	0.97
<u>PISCES</u>				
(Cold temperate) Europe	10	-19.99	2.92	0.93
(Cool temperate) Elandsbay, South Africa(12)	3	-17.34	1.35	0.78
(Warm temperate) Redfish Bay	7	-12.87	2.75	0.97
<u>AVES</u>				
(Cold) Europe : Eiderduck	2	-19.25		
<u>MAMMALIA</u>				
(Cold Europe (Whale)	3	-26.53	1.76	1.01
Europe (Polar bear)	8	-20.28	0.91	0.32

Data for:- MOLLUSCA : Parker (1964)
Erlenkeuser *et al* (1975)
Silberbauer (1976)

CRUSTACEAE : Parker (1964)

PISCES : Parker (1964)
Farmer *et al* (1972)
Harkness & Walton (1972)
Stenhouse & Baxter (1976)
Silberbauer (1976)

AVES : Olsson (1959)

MAMMALIA : Harkansson (1972, 1975, 1976)
Williams & Johnson (1976)

TABLE VII

TABLE SHOWING THE EXPECTED $\delta^{13}\text{C}$ VALUES FOR MARINE BIOTA IN A
WARM TEMPERATE REGION.

	\bar{x} /mil.
plankton (oceanic)	-20.6
marine algae	-15.7
macrophytes	- 9.5
filter feeders	-16.0
grazers	-13.0
Crustaceae	-14.8
fish (coastal)	-12.8
marine birds	-14.4
carnivores (i.e. seals)	-15.4

TABLE VIII

 ^{13}C CONTENT OF FRESHWATER PLANTS FROM VARIOUS WATER STATES

Calculation of the mean (\bar{x}), standard deviation (S_x) and standard error of various freshwater plants.

Water State	f	\bar{x}	S_x	$S_{\bar{x}}$
Plant type		/mil	/mil	/mil
Soft/Medium hard Submerged plants	6	-17.97	2.10	0.86
Hard Submerged plants	3	-14.73	0.96	0.55
Soft Surface plants	4	-25.65	1.65	0.83
Medium hard Surface plants	5	-23.14	0.89	0.40
Plankton	3	-31.43	4.50	2.60
Total sample	21	-22.11	5.75	1.25

Data from : Oane & Deevey (1960)

Stuiver et al (1963)

Stuiver & Deevey (1961; 1962)

TABLE IX

TABLE SHOWING THE PRINCIPAL EDIBLE PLANT FOODS FROM
MELKHOUTBOOM CAVE, SCOTT'S CAVE, HIGHLANDS ROCK SHELTER,
SPRINGS ROCK SHELTER, AND THEIR ISOTOPIC STATUS.

TRIDACEAEWatsonia spp.C₃Moraea spp.C₃Tritonia spp.C₃Freezia spp.C₃HYPOXIDACEAEHypoxis spp.C₃CYPERACEAE (appears @ 2000 yrs.BP)Cyperus usitatusC₃OXALIDACEAEOxalis spp. (surface levels only)C₃Podocarpus /alcatusC₃Schotia sp.C₃

H.J. Deacon (1976:212-214)

LIST OF DOMESTICATED PLANTS KNOWN TO HAVE FORMED DIETARY
STAPLES OF AGRICULTURALISTS.

MAIZE (after 1500 AD)

C₄

SORGHUM

C₄

MILLET

C₄

TABLE X

TABLE SHOWING THE EXPECTED MEAN $\delta^{13}\text{C}$ VALUES FOR TERRESTRIAL ANIMALS MEAT FOR THE ALBANY, WILTON, POST-CLIMAX WILTON, PASTORALISTS AND AGRICULTURALISTS.

	BROWSERS @ -26.5 /mil	*MIXED FEEDERS @ -14.8 /mil	$\delta^{13}\text{C}$ /mil
ALBANY	40%	60%	-19.4
WILTON	70%	30%	-22.9
P.C. WILTON	70%	30%	-22.9
PASTORALISTS	20%	80%	-17.1
AGRICULTURALISTS	10%	90%	-15.9

- These values are all subject to the presence of C_4 grasses in the Eastern Cape - if absent all meat $\delta^{13}\text{C}$ values would average -26.5/mil.

TABLE XI

TABLE SHOWING OTHER SOURCES OF EDIBLE FOODS WHICH ARE REPRESENTED IN CAVE DEPOSITS.

	MELKHOUTBOOM	WILTON LARGE ROCK SHELTER	SLOTT'S CAVE	HIGHLANDS	ANDRIES KRAAL
TORTOISE	x	x		x	
OSTRICH EGG SHELL	x	x	x	xx	x
FRESHWATER MUSSEL	xx	xx	xx	x	xx
CRAB	x	x	x	x	x
FISH		x			
LIZARD	x			x	
BIRDS			x		x
	x	present			
	xx	abundant			

Data from : J. Deacon (1969)
H.J. Deacon (1976)

TABLE XII

TABLE SHOWING THE FREQUENCIES AND PERCENTAGES OF GRAZING VERSUS FILTER-FEEDING MOLLUSCS FROM COASTAL SITES IN THE EASTERN CAPE.

	2/3				2/4							
	STORMS		STORMS		STORMS		ESCOURT		ESCOURT		TOTAL	
	RIVER		RIVER		RIVER		MIDDEN		MIDDEN		SAMPLE	
	SITE 1		SITE 2		SITE 2		CUTTING 1		CUTTING 2			
	f	%	f	%	f	%	f	%	f	%	f	%
GRAZERS	667	90.5	299	66.0	357	56.7	156	30.4	31	37.8	1520	62.6
FILTER FEEDERS	71	9.49	154	33.9	272	43.2	357	69.5	51	62.1	905	37.3
TOTAL	748	99.9	453	99.9	629	99.9	513	99.9	82	99.9	2425	99.9

Data from:- H.J. Deacon (1970)
Cairns (1975)

TABLE XIII

TABLE SHOWING THE CALCULATION OF THE MEAN EXPECTED $\delta^{13}\text{C}$ VALUE FOR MARINE FOODS IN THE EASTERN CAPE

SUBCATEGORY	$\delta^{13}\text{C}$ VALUE @ /mil	% of SUB-CATEGORY	$\delta^{13}\text{C}$ /mil
<u>Carnivores</u>			
Seals	-15.4	50	-7.7
Birds	-14.4	50	-7.2
			<u>-14.9</u>
<u>Carni + Fish:</u>			
Carnivores	-14.9	60	-8.9
Fish	-12.8	40	-5.1
			<u>-14.0</u>
<u>Carni + Fish + Moll.</u>			
Carni + fish	-14.0	30	-4.2
Molluscs	-14.2	70	-9.9
			<u>-14.1</u>

MEAN EXPECTED MARINE $\delta^{13}\text{C}$ VALUE = -14.1/mil.

TABLE XIV

TABLE SHOWING THE MEAN ^{13}C VALUES USED IN THE CALCULATION
OF HYPOTHETICAL DIETS FOR ALBANY, WILTON, POST-CLIMAX WILTON,
PASTORALISTS, AND PASTORALISTS/AGRICULTURALISTS.

	\bar{x} /mil
<u>^{13}C ENRICHED FOODS</u>	
Marine foods	-14.1
Mixed feeders	-14.8
Domesticated C_4 plants	-12.5
<u>^{13}C DEPLETED FOODS</u>	
C_3 plant foods	-26.5
Browsers	-26.5

TABLE XV

TABLE SHOWING THE CALCULATION OF THE EXPECTED MEAN $\delta^{13}\text{C}$ VALUE FOR ALBANY POPULATIONS.

SUBCATEGORY	$\delta^{13}\text{C}$ VALUES @ /mil	% of TOTAL DIET	% of SUB-CATEGORY	$\delta^{13}\text{C}$ /mil
<u>Animal diet</u>				
Browsers	-26.5	25.2	40	-10.6
Mixed feeders	-14.8	37.8	60	- 8.8
				<u>-19.4</u>
<u>Terrestrial diet</u>				
Plants (C_3)	-26.5	27.0	30	- 7.9
Meat	-19.4		70	-13.6
				<u>-21.5</u>
<u>Overall diet</u>				
Terrestrial foods	-21.5		90	-19.3
Marine foods	-14.1	10.0	10	- 1.4
				<u>-20.7</u>

MEAN EXPECTED COLLAGEN $\delta^{13}\text{C}$ VALUE = -15.6/mil.

TABLE XV

TABLE SHOWING THE CALCULATION OF THE MEAN EXPECTED $\delta^{13}\text{C}$ VALUE FOR ALBANY POPULATIONS TAKING INTO ACCOUNT THE ABSENCE OF C_4 GRASSES IN THE EASTERN CAPE.

SUB-CATEGORY	$\delta^{13}\text{C}$ VALUE @ /mil	% of TOTAL DIET	% of SUB-CATEGORY	$\delta^{13}\text{C}$ /mil
<u>Animal diet</u>				
Browsers	-26.5	25.2	40	-10.6
Mixed feeders	-14.8	37.8	60	-15.9
				<u>-26.5</u>
<u>Terrestrial diet</u>				
Plants (C_3)	-26.5	27.0	30	- 7.95
Meat	-26.5		70	-18.5
				<u>-26.5</u>
<u>Overall diet</u>				
Terrestrial	-26.5		90	-23.8
Marine	-14.1	10.0	10	- 1.4
				<u>-25.2</u>

EXPECTED MEAN COLLAGEN $\delta^{13}\text{C}$ VALUE = -20.1 /mil.

TABLE XVI

TABLE SHOWING THE CALCULATION OF THE MEAN $\delta^{13}\text{C}$ VALUE OF FORMATIVE, DEVELOPED AND CLIMAX WILTON POPULATIONS.

SUB-CATEGORY	$\delta^{13}\text{C}$ VALUE @ /mil	% OF TOTAL DIET	% OF SUB-CATEGORY	$\delta^{13}\text{C}$ /mil
<u>ANIMAL DIET</u>				
Browsers	-26.5	14.7	70	-18.5
Mixed feeders	-14.3	6.3	30	- 4.4
				<u>-22.9</u>
<u>TERRESTRIAL DIET</u>				
Plants (C_3)	-26.5	49.0	70	-18.5
Meat	-22.9		30	- 6.8
				<u>-25.4</u>
<u>OVERALL DIET</u>				
Terrestrial foods	-25.4		70	-17.8
Marine foods	-14.1	30.0	30	- 4.2
				<u>-22.0</u>

MEAN EXPECTED COLLAGEN $\delta^{13}\text{C}$ VALUE = -16.9 /mil.

TABLE XVII

TABLE SHOWING THE CALCULATION OF THE MEAN EXPECTED $\delta^{13}\text{C}$ VALUE FOR POST-CLIMAX WILTON POPULATIONS.

SUB-CATEGORY	$\delta^{13}\text{C}$ VALUE @ /mil	% OF TOTAL DIET	% OF SUB-CATEGORY	$\delta^{13}\text{C}$ /mil
<u>Animal diet</u>				
Browsers	-26.5	10.5	70	-18.5
Mixed feeders	-14.8	4.5	30	- 4.4
				-22.9
<u>Terrestrial diet</u>				
Plants (C_3)	-26.5	35.0	70	-18.5
Meat	-22.9		30	- 6.8
				-25.4
<u>Overall diet</u>				
Terrestrial foods	-25.4		50	-12.7
Marine foods	-14.1	50	50	- 7.0
				-19.7

MEAN EXPECTED COLLAGES $\delta^{13}\text{C}$ VALUE = -14.6 /mil.

TABLE XVIII

TABLE SHOWING THE CALCULATION OF THE EXPECTED MEAN $\delta^{13}\text{C}$ VALUE FOR PASTORALISTS.

SUB-CATEGORY	$\delta^{13}\text{C}$ VALUE @ /mil	% OF TOTAL DIET	% OF SUB-CATEGORY	$\delta^{13}\text{C}$ /mil
<u>Animal diet</u>				
Browsers	-26.5	11.2	20	- 5.3
Mixed feeders	-14.8	44.8	80	-11.8
				<u>-17.1</u>
<u>Terrestrial diet</u>				
Plant foods (C_3)	-26.5	24.0	30	- 7.9
Meat	-17.1		70	-11.9
				<u>-19.9</u>
<u>Overall diet</u>				
Marine foods	-14.1	20.0	20	- 2.8
Terrestrial	-19.9		80	-15.9
				<u>-18.7</u>

MEAN EXPECTED COLLAGEN $\delta^{13}\text{C}$ VALUE = -13.6 /mil.

TABLE XIX

TABLE SHOWING THE CALCULATION OF THE MEAN EXPECTED $\delta^{13}\text{C}$ VALUE FOR PASTORALISTS WHO HAVE INCORPORATED C_4 DOMESTICATES IN THEIR DIET OR ALTERNATIVELY AGRICULTURALISTS.

SUB-CATEGORY	$\delta^{13}\text{C}$ VALUE @ /mil	% OF TOTAL DIET	% OF SUB-CATEGORY	$\delta^{13}\text{C}$ /mil
<u>Animal diet</u>				
Browsers	-26.5	3.6	10	- 2.6
Mixed feeders	-14.8	32.4	90	-13.3
				<u>-15.9</u>
<u>Terrestrial diet</u>				
Meat	-15.9		40	- 6.3
Plants (C_4)	-12.5	54.0	60	- 7.5
				<u>-13.8</u>
<u>Overall diet</u>				
Terrestrial foods	-13.8		90	-12.4
Marine	-14.1	10	10	- 1.41
				<u>-13.8</u>

MEAN EXPECTED COLLAGEN $\delta^{13}\text{C}$ VALUE = -8.7 /mil.

TABLE XX

TABLE SHOWING SKELETONS WHICH ARE EITHER RADIOCARBON DATED,
OR HAVE ASSOCIATED RADIOCARBON DATES.

Seal Point	: 261B	^{14}C dated to 5180 ± 65 yrs. B.P. (Pta 1089)
Wilton LR.S.	: 146B	^{14}C dated to 8260 ± 720 yrs. B.P. (Gak - 1541)
Meelkhoutboom	: 263B	^{14}C associated date 2870 ± 90 yrs B.P. (Pta - 706)
Melkhoutboom	: 262B	^{14}C associated date 7200 ± 80 yrs B.P. (UW 234)

TABLE XXI

KEY

- A. Location.
1. Cave burial.
 2. Open inland burial.
 3. Open coastal burial.
- B. Burial covering.
4. Slab or rock.
 5. Pile of stones or cairn.
 6. Nothing.
 7. Not recorded.
- C. Body position.
8. Horizontal flexed (body placed on its back with legs and arms flexed).
 9. Vertical flexed (body placed in the upright position and limbs flexed).
 10. Side flexed (body placed on the side with limbs flexed).
 11. Indeterminate.
- D. Shaft preparation in relation to the body.
12. Stone or stones placed below the body.
 13. Stone or stones placed above the body.
 14. Stone or stones placed around the body.
 15. Body placed on bedrock.
 16. No preparation in relation to the body.
- E. Associated material.
17. Directly associated material (i.e. material actually placed in the grave for some ritual importance).
 18. Indirectly associated material (i.e. material which somehow became incorporated in the grave which would not have any ritual significance).
 19. No associated material.
- F. Associated material specific.
20. Pottery or any ceramic material.
 21. Items of personal adornment found associated with burial.
 22. Ochre.
 23. Fauna of any kind.
 24. Shells.
 25. Stone or bone artefacts.
- G. Sex.
26. Male.
 27. Female.
 28. Indeterminate.
- H. Age classes.
29. Infant (non-child whose age is not determined).
 30. Child (1 to 6 years).
 31. Juvenile (6 to 11 years).
 32. Sub-adult (12 to 20 years).
 33. Young adult (20 to 24 years).
 34. Adult (25 to 29 years).
 35. Mature adult (30 to 34 years).
 36. Old adult (35 years +).

TABLE XXI

TABLE SHOWING THE GROUPING OF SUB-CATEGORIES FOR CHI-SQUARE ANALYSIS.

<u>CATEGORIES</u>	<u>TOTAL</u>
A. Location	
(1)	15
(2, 3)	24
B. Burial Covering	
(4)	14
(5)	18
C. Body Position	
(8)	3
(9)	16
(10)	13
D. Shaft Preparation	
(12, 13, 14, 15)	13
(16)	26
E. Associated Material (General)	
(17)	20
(19)	17
F. Associated Material Specific	
(21, 22, 24)	20
(20, 23)	11
(25)	10
H. Age Classes	
(29, 30, 31)	17
(32, 33, 34)	12
(35, 36)	10

TABLE XXII

TABLE SHOWING SIGNIFICANT AND NON-SIGNIFICANT ASSOCIATIONS
BETWEEN BURIAL CATEGORIES.

	A	B	C	D	E	F	H
A							
B	*						
C	*	*					
D	*	*	*				
E	o	o	o	o			
F	o	o	*	o			
H	o	o	o	o	o	o	

p = 0.05

* = significant

o = not significant

KEY

A - LOCATION

B - BURIAL COVERING

C - BODY POSITION

D - SHAFT PREPARATION

E - ASSOCIATED MATERIAL (GENERAL)

F - ASSOCIATED MATERIAL (SPECIFIC)

H - AGE CLASSES

TABLE XXIII

TABLE SHOWING BURIALS WHICH EXHIBIT A PASTORALIST OR HUNTER-GATHERER BURIAL PATTERN. 'UNKNOWN'S' AND INDIVIDUALS FROM A MASS GRAVE ARE ALSO LISTED.

PASTORALISTS

KEY: A = CAIRN; B = VERTICAL FLEXED BODY POSITION;
C = SHAFT PREPARATION; E = ROCK(S) OR SLAB(S);
F = SIDE FLEXED; G = ASSOCIATED ITEMS OF PERSONAL
ADORNMENT.

SITE	HS	UCT	A*	B	C	TOTAL
Dunbrody	184	146B	•	•	•	3
Dunbrody	183	123B	•	•	•	3
Bowden	216	134B	•	•		2
Governorskop	235	157B	•	•	•	3
Retreat	186	138B	•	•	•	3
Retreat	179	130B	•			1
Retreat	187	129B			•	1
Kleinpoort	174	131B	•	•	•	3
Kleinpoort	175	116B	•			1
Kleinpoort	176	189B	•	•	•	3
Kleinpoort	177	122B	•	•	•	3
Kleinpoort	178	153B	•	•	•	3
Kleinpoort	181	104B	•	•	•	3
Lakeside	182	137B	•	•		2
Kleinpoort	193	150B	•	•		2
Kleinpoort	197	127B	•	•		2
Bretton Beach	246	144B	•	•	•	3

TABLE XXIII (cont.)

HUNTER-GATHERERS

* These burials are considered to be Hunter-gatherer burials, as the records mention attributes common to this type, but not to individual skeletons (see Appendix A).

TABLE XXIII (cont.)

HUNTER-GATHERERS

SITE	HS	UCT	E	F	G	TOTAL
* Kabeljauws A	160a	120B				
* Kabeljauws A	161a	117B				
* Kabeljauws B	151a	121B				
* Spitzkop	128a	174B				
* Spitzkop	128b	175B				
* Spitzkop	128c	176B				
* Spitzkop	128d	173B				
* Spitzkop	128e	208B				
* Spitzkop	128f	177B				
* Spitzkop	128g	178B				
* Spitzkop	128h	209B				
* Spitzkop	131	179B				
* Spitzkop	132	180B				
* Spitzkop	133	181B				
* Spitzkop	135	182B				
* Spitzkop	136	183B				
* Spitzkop	138	185B				
* Spitzkop	139	186B				
* Seal Point	223	115B				1
SITE	I'S	UCT	E	F	G	TOTAL
Sea Vista	278	159B				1
Seal Point		261B				2
Wildome	238	155B				1
Mitford Park	236	128B				1
Vygeboom	198	105B				3
Vygeboom	199	125B				3
Vygeboom	200	126B				3
Melkhoutboom		263B				2
Melkhoutboom		262B				1
Wilton L.R.S.	119	146B				2
Wilton L.R.S.	116	171B				3
Wilton L.R.S.	122	169B				3
Wilton Cave	120	168B				3
Wilton Cave	121	135B				3
Salem	190a	098B				1
Salem	190b	(99)				1
Salem	190c	100B				1
New Gloucester	265	158B				1
Melkhoutboom	195a	147B				2
Kabeljauws A	150c	118B				1

TABLE XXIII (cont.)

UNKNOWN

<u>SITE</u>	<u>HS</u>	<u>UCT</u>
Glen Ovis	218	163B
Port Alfred	108	156B
Port Alfred	126	139B
Kleinpoort	127	164B
Kleinemonde	221	145B
Mookkrantz	204	106B
Middlekop	205	114B

MASS BURIAL

Paardefontein	244d	111B
"	244b	109B
"	244c	112B
"	244a	108B

All the above listed burials were sampled for
¹³C analysis.

TABLE XXIV

TABLE LISTING ALL $\delta^{13}\text{C}$ VALUES FOR PASTORALISTS HUNTER-GATHERERS, UNKNOWNNS, AND MASS BURIALS.

PASTORALISTS			
SITE	HS	UCT	$\delta^{13}\text{C}$ /mil
Dunbrody	184	148B	-12.4
Dunbrody	183	123B	-14.8
Bowden	216	134B	- 8.2
Governorskop	235	157B	- 8.3
Retreat	186	138B	-11.0
Retreat	179	130B	-10.2
Retreat	187	129B	-11.2
Kleinpoort	174	131B	- 8.8
Kleinpoort	175	116B	- 7.8
Kleinpoort	176	189B	- 8.3
Kleinpoort	177	122B	- 8.8
Kleinpoort	178	153B	-13.0
Kleinpoort	181	104B	- 8.9
Lakeside	182	137B	-13.4
Kleinpoort	193	150B	- 7.8
Kleinpoort	197	127B	-13.8
Bretton Beach	246	144B	-10.7

(n)	\bar{x}	S_x	$S_{\bar{x}}$	(r)	
17	-15.75	2.45	0.58	-12.9	- 19.9
17	-10.66	2.44	0.58	- 7.8	- 14.8

TABLE XXIV (cont.)

HUNTER-GATHERERS

SITE	HS	UCT	$\delta^{13}\text{C}$ /mil
Spitzkop	128a	174B	-12.7
"	128b	175B	-10.4
"	128c	176B	-15.1
"	128d	173E	-9.2
"	128e	208B	-14.6
"	128f	177B	-14.5
"	128g	178B	-13.1
"	128h	209B	-13.5
"	131	179B	-12.5
"	132	180B	-14.2
"	133	181B	-12.8
"	135	182B	-12.9
"	136	183B	-13.3
"	138	185B	-11.2
"	139	186B	-11.3
n	\bar{x}	S_x	$S_{\bar{x}}$
39	-12.9	2.04	0.30

TABLE XXIV (cont.)

HUNTER-GATHERERS

SITE	HS	UCT	$\delta^{13}\text{C}$ /mil
Sea Vista	278	159B	-12.6
Seal Point	261B		-13.4
Seal Point	223	115B	-13.9
Kabeljauws A	150c	118B	-12.4
Kabeljauws A	160a	120B	-14.7
Kabeljauws A	161a	117B	-11.9
Kabeljauws B	151a	121B	-12.6
Widcome	236	155B	-15.4
Vygeboom	198	105B	-15.3
Vygeboom	199	125B	-10.0
Vygeboom	200	126B	-12.1
Melkhoutboom	263B		-13.2
Melkhoutboom	262B		-16.8
Melkhoutboom	195a	147B	-15.7
Wilton L.R.S.	119	146B	-16.9
Wilton L.R.S.	116	171B	-14.0
Wilton L.R.S.	122	169B	-10.0
Wilton Cave	120	168B	-12.0
Wilton Cave	121	135B	-14.4
Salem	190a	098P	-12.6
Salem	190b	099B	-11.9
Salem	190c	100B	-13.7
New Gloucester	265	158B	-13.5
Mitford Park	236	128B	-13.7

TABLE XXIV (cont.)

UNKNOWNIS AND MASS BURIAL

SITE	HS	UCT	$\delta^{13}\text{C}$ /mil
Glen Ovis	218	163B	-14.4
Port Alfred	108	156B	- 8.2
Port Alfred	126	139B	-15.0
Kleinpoort	127	164B	-11.0
Kleinemonde	221	145B	-11.4
Moolkrantz	204	106B	-14.7
Middlekop	205	114B	- 8.3
Paardefontein	244d	111B	-12.7
"	244b	109B	-12.2
"	244c	112B	-11.3
"	244a	108B	-11.3

TABLE LISTING BURIALS ACCORDING TO GROUPS 1, 2, 3 and 4.

KEY:

A = Child or infant	\bar{x} = mean
B = Juvenile	S_x = standard deviation
C = Older than juvenile	$S_{\bar{x}}$ = standard error
D = Pastoralist	(n) = number
E = Hunter-gatherer	(r) = range
F = $\delta^{13}\text{C}$ value (collagen)	δ = male
G = $\delta^{13}\text{C}$ value (food source)	ϕ = female

GROUP 1

	A	B	C	D	E	F	G
150B Kleinpoort	C			P		-7.8 -12.9	
116B Kleinpoort	C			P		-7.8 -12.9	
134B Bowden			A ϕ	P		-8.2 -13.3	
156B Port Alfred		J				-8.2 -13.3	
157B Governorskop			MA δ	P		-8.3 -13.4	
189B Kleinpoort		J		P		-8.3 -13.4	
114B Middlekop	C					-8.3 -13.4	
122B Kleinpoort			MA ϕ	P		-8.8 -13.9	
131B Kleinpoort			MA ϕ	P		-8.8 -13.9	
104B Kleinpoort		J		P		-8.9 -14.0	
173B Spitzkop	I				H	-9.2 -14.3	
n = 11	4	3	4	8	1		

	\bar{x}	S_x	$S_{\bar{x}}$	(n)	(r)
F	-8.42	0.45	0.14	11	-7.8 to -9.2
G	-13.52	0.45	0.14	11	-12.9 to -14.3
A	-8.28	0.66	0.33	4	-7.8 to -9.2
B	-8.47	0.38	0.22	3	-8.2 to -8.9
A + D	-7.80			2	
B + D	-8.60			2	
C + D	-9.53	0.32	0.16	4	-8.2 to -9.8
E	-9.2			1	
D	-8.36	0.44	0.15	8	-7.8 to -9.9

GROUP 2

	A	B	C	D	E	F	G
125B Vygeboom			SA ϕ		H	-10.0 -15.1	
109B Wilton L.R.S.	C				H	-10.0 -15.1	
130B Retreat			A ϕ	P		-10.2 -15.3	
175B Spitzkop	I				H	-10.4 -15.5	
144B Bretton Beach			YA ϕ	P		-10.7 -15.8	
132B Retreat			A ϕ	P		-11.0 -16.1	
164B Kleinpoort			SA			-11.0 -16.1	
129B Retreat			A	P		-11.2 -16.3	
183B Spitzkop	C				H	-11.2 -16.3	
185B Spitzkop			YA		H	-11.3 -16.4	
102B Paardefontein	C					-11.3 -16.4	
112B Paardefontein	C					-11.3 -16.4	
145B Kleinemonde	C					-11.4 -16.5	
n = 13	6	0	7	4	5		

	\bar{x}	S_x	$S_{\bar{x}}$	(n)	(r)
F	-10.85	0.52	0.15	13	-10.0 to -11.4
G	-15.95	0.52	0.15	13	-15.1 to -16.5
A	-10.93	0.59	0.24	6	-10.0 to -11.4
C	-10.79	0.47	0.18	7	-10.0 to -11.3
D	-10.78	0.43	0.22	4	-10.2 to -11.2
E	-10.58	0.63	0.28	5	-10.0 to -11.3
C + D	-10.76	0.43	0.77	4	-10.2 to -11.2

TABLE XXVI b

TABLE SHOWING THE CALCULATION OF AN ALTERNATIVE MEAN EXPECTED $\delta^{13}\text{C}$ VALUE FOR GROUP 3 HUNTER-GATHERERS. THE OVERALL MARINE COMPONENT IN THE DIET IS INCREASED.*

SUB-CATEGORY	$\delta^{13}\text{C}$ VALUE @ /mil	% OF TOTAL DIET	% OF SUB-CATEGORY	$\delta^{13}\text{C}$ /mil
<u>Animal diet</u>				
Browsers	-26.5	8.4	70	-18.5
Mixed feeders	-14.8	3.6	30	-4.4
				-22.9
<u>Terrestrial diet</u>				
Plants (C_3)	-26.5	28.0	70	-18.5
Meat	-22.9		30	-6.8
				-25.4
<u>Overall diet</u>				
Terrestrial diet	-25.4		40	-10.1
Marine	-14.1	60.0	60	-8.4
				-18.6

MEAN EXPECTED COLLAGEN $\delta^{13}\text{C}$ VALUE = -13.5 /mil.

TABLE XXVI d

TABLE SHOWING THE CALCULATION OF AN ALTERNATIVE MEAN EXPECTED $\delta^{13}\text{C}$ VALUE FOR HUNTER-GATHERERS IN GROUP 3. MIXED FEEDERS AND MEAT ARE INCREASED AND MARINE FOODS ARE EQUAL IN IMPORTANCE TO THE OVERALL TERRESTRIAL DIET.*

SUB-CATEGORY	$\delta^{13}\text{C}$ VALUE @ /mil	% OF TOTAL DIET	% OF SUB-CATEGORY	$\delta^{13}\text{C}$ /mil
<u>Animals</u>				
Browsers	-26.5	7.0	20	-5.3
Mixed feeders	-14.8	26.0	80	-11.8
				-17.1
<u>Terrestrial</u>				
Plants (C_3)	-26.5	15.0	30	-7.9
Terrestrial foods	-17.1		70	-11.9
				-15.0
<u>Overall diet</u>				
Terrestrial food			50	-9.9
Marine foods	-14.1	50	50	-7.0
				-17.0

EXPECTED MEAN COLLAGEN $\delta^{13}\text{C}$ VALUE = -11.9 /mil.

TABLE XXVI a

TABLE SHOWING THE CALCULATION OF AN ALTERNATIVE MEAN EXPECTED $\delta^{13}\text{C}$ VALUE FOR GROUP 3 HUNTER-GATHERERS. THE MIXED FEEDER COMPONENT IN THE DIET IS INCREASED.*

SUB-CATEGORY	$\delta^{13}\text{C}$ VALUE @ /mil	% OF TOTAL DIET	% OF SUB-CATEGORY	$\delta^{13}\text{C}$ /mil
<u>Animal diet</u>				
Browsers	-26.5	6.3	30	-7.9
Mixed feeders	-14.8	14.7	70	-10.2
				-17.6
<u>Terrestrial diet</u>				
Plant foods (C_3)	-26.5	49.0	70	-18.5
Meat	-17.8		30	-5.3
				-23.9
<u>Overall diet</u>				
Terrestrial diet	-23.9		70	-16.7
Marine diet	-14.1	30	30	-4.2
				-20.9

MEAN EXPECTED COLLAGEN $\delta^{13}\text{C}$ VALUE = -15.8 /mil.

TABLE XXVI c

TABLE SHOWING THE CALCULATION OF AN ALTERNATIVE MEAN EXPECTED $\delta^{13}\text{C}$ VALUE FOR HUNTER-GATHERERS IN GROUP 3. MIXED FEEDERS AND MARINE FOODS ARE INCREASED AT THE EXPENSE OF C_3 PLANT FOODS.*

SUB-CATEGORY	$\delta^{13}\text{C}$ VALUE @ /mil	% OF TOTAL DIET	% OF SUB-CATEGORY	$\delta^{13}\text{C}$ /mil
<u>Animal</u>				
Browsers	-26.5	14.4	40	-10.6
Mixed feeders	-14.8	21.6	60	-9.8
				-19.4
<u>Terrestrial</u>				
Plant foods (C_3)	-26.5	24.0	40	-10.6
Meat	-19.4		60	-11.6
				-22.2
<u>Overall</u>				
Terrestrial foods	-22.2		60	-13.3
Marine	-14.1	40	40	-5.6
				-18.9

MEAN EXPECTED COLLAGEN $\delta^{13}\text{C}$ VALUE = -13.8 /mil.

TABLE XXVII

TABLE SHOWING THE CALCULATION OF AN ALTERNATIVE MEAN EXPECTED $\delta^{13}\text{C}$ VALUE FOR PASTORALISTS/AGRICULTURALISTS IN GROUP 2. MIXED FEEDERS AND OVERALL MEAT DIET IS INCREASED. MARINE FOODS ARE DECREASED.*

SUB-CATEGORY	$\delta^{13}\text{C}$ VALUE @ /mil	% OF TOTAL DIET	% OF SUB-CATEGORY	$\delta^{13}\text{C}$ /mil
<u>Animals</u>				
Browsers	-26.5	12.6	20	- 5.3
• Mixed feeders	-14.8	50.4	80	-11.8
				-17.1
<u>Terrestrial diet</u>				
• Meat	-17.1		70	-11.9
C_4 plants	-12.5	27.0	30	- 3.7
				-15.7
<u>Overall diet</u>				
Terrestrial	-15.7		90	-14.1
• Marine	-14.1	10	10	- 1.4
				-15.5

EXPECTED MEAN COLLAGEN $\delta^{13}\text{C}$ VALUE = -10.4 /mil.

APPENDIX A

BURIAL SITE REPORTS.

This section presents all the relevant information known about burials, archaeological sites and human skeletal material sampled from the area defined as the Eastern Cape (see Figure 1). Much of the information presented here is unpublished, as most of the data recorded comes from the Albany Museum Accession Register, personal field notes, private correspondence and some published works. These sources are acknowledged. The age, sex and minimum numbers of human skeletal material sampled have been determined with the aid of physical anthropologists. The same format is used in the layout of data for each individual burial. The categories used in the presentation of this data are considered important, as they tell one more about past mortuary practices in both spatial and chronological dimensions. This information is further used in Chapter V to group these burials on the basis of shared attributes.

As these burials represent a collection excavated over a period of 70 years by different individuals, it is difficult in many instances to obtain a full list of categories on each site. Many aspects of these burials considered important to archaeologists are absent, therefore some categories are not complete. However, all that is intended is the presentation of the basic information which is examined in detail in Chapter V. Finally, full responsibility is accepted by the author for any misinterpretation of the original sources as is revealed in the following pages.

1. Burial no:

HS184/UCT148B.

Site:

Dunbrody. (33°33'S;25°33'E).

Location:

This site is situated on an open plain about 100yds from the east bank of the Sundays river, farm Dunbrody, Kirkwood district.

Excavators:

Rev. P. Stapleton and Mr. J. Hewitt.

Date of excavation:

September 1928.

Age and sex of individual:

A mature adult, approximately 35yrs. of age, sex male.

Burial covering:

A large circle of boulders about 12ft. in diameter. The whole area covering the grave was a bit sunken.

Shaft preparation:

The shaft was six to eight feet in depth. A large stone slab about 2ft square was recovered directly above the skeleton.

Body position:

The mode of burial was not clear, as the skeleton was not stretched out and the humerus was vertical. The body was probably interred in a sitting posture in the grave, but subsequently collapsed due to the weight of the stones above.

Associated material:

One grindstone was found in the cairn.

Sources:

Albany Museum Accession Register.

2. Burial no:

HS183/UCT123B.

Site:

Dunbrody. (33°33'S;25°33'E).

Location:

The site is situated on the east bank of the Sundays river, on the farm Dunbrody, Kirkwood district.

Excavators:

Rev. Stapleton and Mr. J. Hewitt.

Date of excavation:

September 1928.

Age and sex of individual:

A child aged approximately six years, sex indeterminate.

Burial covering:

A circular stone structure consisting of large boulders.

Shaft preparation:

Some of the boulders were packed carefully around the body, forming a circle at the top. No stones were found beneath the skeleton. The skeleton was located at a depth of 5ft.

Body position:

The skeleton was found in a semi-squatting position.

Associated material:

Shells of the fresh water mussel, Cafferia
caffer were found in the grave.

Notes:

The presence of fresh water mussel middens in the vicinity of the above grave (Hewitt & Stapleton 1919), suggests that the grave and the sites could be broadly contemporary.

Sources:

Hewitt & Stapleton (1919).

Albany Museum Accession Register.

3. Burial no:

HS216/UCT1348.

Site:

Bowden. (32°58'S; 26°58'E).

Location:

Farm Bowden, Fish River Rand, Bedford district.

Excavators:

Mr. J. Hewitt and Dr. L. Caiger.

Date of excavation:

19th June 1934.

Age and sex of individual:

An adult male of about 30 to 35 years of age.

Burial covering:

The burial covering consisted of a large mound of boulders about 20yds in circumference and rising at the centre to about 3ft above the ground. At the margins, large stones were deliberately planted in the ground, more or

less in a circle. The stones were angular and shapeless, some up to 20lbs in weight.

Shaft preparation:

None recorded.

Body position:

The body was interred in the sitting position, the humeri were nearly vertical and the legs were flexed fully at the knees which were touching. The elbows were bent at right-angles to the body. The body was facing west.

Associated material:

Not far from the grave about 10yds, fragments of red pottery were found. One rim fragment had a lined pattern. The implements found on the flats near the grave are of the 'pebble phase' of the Smithfield 'A'. No grave goods were found with the skeleton.

Notes:

Dr. Drury suggests that the total height of this individual would be about 6ft 5 ins. On cranial characteristics Dr. Dreyer suggests Khoisanoid affinities.

Sources:

Albany Museum Accession Register.

4. Burial no:

HS235/UCT157B.

Site:

Lower Governorskop Farm. (33°18'S;26°46'E).

Location:

Lower Governorskop farm, near Grahamstown,
Albany district.

Excavators:

Mr. W. Pannell and Mr. J. Hewitt.

Date of excavation:

19th September 1937.

Age and sex of individual:

An old adult male of about 40 to 50 years of age.

Burial covering:

Large stones were found over an area not more than 6ft in diameter. The stones were not arranged in any pattern, but in places they were packed carefully. The stones of the cairn were mostly slabs averaging 15lbs in weight.


Shaft preparation:

A few stones were found in the shaft. At approximately 2ft in depth there were two large stones weighing 45lbs and 35lbs respectively. These were blocks of irregular shape not slabs. The skeleton was found at a depth of 2ft 6in, and was resting on gravel. Stones were packed around the body and over the chest another block weighing 30lbs was recovered.

Body position:

The legs were completely drawn up at the knees. Both arms were outstretched at the sides of the body, one hand being near the hips. It appears

PLATE IV

A photograph taken in 1937 by J. Hewitt, which gives a close up view of the Lower Governorskop skeleton (HS235/UCT157B). This individual is an adult male of about 40 to 50 years of age, and  was buried at a depth of 2ft 6in, with stones packed around and above the skeleton. The grave was covered with a cairn of stone slabs.



That the body was interred in the sitting position, but subsequently subsided downwards so that the vertebral column was nearly horizontal and the head above it.

Associated material:

At 3ft in the shaft a fragment of tortoise bone was found. A fragment of red ochre and an Achatina sp. shell with its top and base broken, plus a fragment of tortoise carapace was found with the skeleton.

Notes:

See plate IV for a photograph of this grave.

Sources:

Albany Museum Accession Register.

5. Burial no:

HS218/UCT163B.

Site:

Glen Ovis. (33°05'S;26°13'E).

Location:

Farm Glen Ovis near Carlisle bridge, Albany district.

Excavators:

Mr. T. Bowker, Mr. J. Norton and Mr. J. Hewitt.

Date of excavation:

1940.

Age and sex of individual:

An adult male of 19 to 25 years of age.

Burial covering:

All that was found was a mound of sand, Hewitt notes that if there was a stone cairn there is a distinct possibility that the stones could have been used to build a wall that is close by.

Shaft preparation:

A good number of long heavy slabs had been placed on and around the body.

Body position:

The skeleton was lying on its back. The legs were flexed at the thighs and knees, which were brought back at the left side of the body.

Associated material:

No associated material was found with this grave.

Notes:

This burial had prior to excavation been disturbed by an antbear. See plate W for photograph of this burial.

Sources:

Albany Museum Accession Register.

6. Burial no:

HS186/UCT138B.

Site:

Retreat. (33°40'S;26°41'E).

Location:

Farm Retreat, on the west side of the Bushmans river, Bathurst district. The site is situated on a high plateau several hundred feet above the river.

PLATE V

This photograph was taken during 1940 at the burial site Glen Ovis (HS218/UCT163B). The skeleton removed from this site is an adult male of 19-to 25 years of age. In this photograph Mr. Bowker is in the grave (left of picture), and the skull is to left. Note the heavy rocks in the foreground which were removed from the grave. The other three persons in this grave are unidentified.



Excavators:

Mr. S.D. Fowlds and Mr. J. Hewitt.

Date of excavation:

1928.

Age and sex of individual:

An adult male in early 30's.

Burial covering:

A large quantity of boulders were piled up over the grave, forming a circle 6 to 7yds in diameter. It was estimated that these stones would be equivalent to six or seven wagon loads of 9000lbs each. (See plate VI a b).

Shaft preparation:

Below the main cairn there was earth to a depth of about 4ft. At this depth large black discoloured boulders, similar to those found in the river bed were recovered. The skeleton was found at a depth of 6ft. At the base of the shaft was gravel.

Body position:

The skeleton was somewhat damaged due to pressure of the boulders from above. It could not be ascertained whether the body had been interred in a sitting position, but evidently it was placed in a huddled position in the grave.

Associated material:

An isolated grindstone was found in the cairn. A pair of copper bangles were taken from the wrist.

PLATE VIa

View of grave excavated by Mr. S. Fowlds and Mr. J. Hewitt on the farm Retreat during 1928. In this picture Mr. S. Fowlds is in the grave with Mrs. S. Fowlds and daughter to the right.

PLATE VIb

A more generalised view of the same grave. In the picture are Mr. S. Fowlds and three helpers. Note the large amount of boulders which have been removed from the grave - suggesting that this burial is the one which had a cairn of stones which was estimated to be equivalent to six or seven wagon loads of 9000 lbs each (HS186/UCT138B).





Notes:

According to Mr. T.F. Dreyer this individual is an old type of Hottentot.

Sources:

Albany Museum Accession Register.

7. ✓ Burial no:

HS179/UCT130B.

✓ Site:

Retreat. (33°40'S;26°41'E).

✓ Location:

This grave is situated on the west side of the Bushmans river on the farm Retreat, Bathurst district.

✓ Excavators:

Mr. J.E. Mylne, Mr. J. Hewitt, Rev. P. Stapleton and Mr. S.D. Fowlds.

✓ Date of excavation:

8th May 1928.

✓ Age and sex of individual:

Adult male in late 20's.

✓ Burial covering:

The grave was covered by a cairn of large stones.

✓ Shaft preparation:

The skeleton was found at a depth of 3ft. The shaft was filled with soil consisting of clay which had hardened considerable.

✓ Body position:

The skeleton was found in a reclining position, with legs bent back at the knees, which were in

a vertical position. The skull was positioned to one side and the mandible was separated therefrom.

Associated material:

No associated grave goods were found.

Sources:

Albany Museum Accession Register.

8. Burial no:

HS187/UCT129B.

Site:

Retreat. (33°40'S; 26°41'E).

Location:

This grave was found near the Bushmans river on the west bank, farm Retreat, Bathurst district.

Excavator:

Mr. S.D. Fowlds.

Date of excavation:

1928.

Age and sex of individual:

Adult, sex indeterminate.

Burial covering:

No form of burial covering recorded.


Shaft preparation:

Little information is known about shaft preparation of this burial, but the skeleton was found to be sitting on a stone.

Body position:

The body had been interred in a sitting position.

Associated material:

No directly associated material was found with this grave, but this burial and HS179, are situated approximately 50yds from an implement site. 

Notes:

Although there is little information about this burial, it is suggested that this grave was in fact very similar to the other two internments on this farm, but did not warrant a full description in the records. However, it is realised that there is a slight difference in shaft preparation in this grave, this being a stone situated under the skeleton.

Sources:

Albany Museum Accession Register.

9. Burial no:

HS174/UCT131B.

Site:

Kleinpoort. (33°15'S;26°45'E).

Location:

Grave on farm Kleinpoort near Committees, Albany district.

Excavator:

Mr. L. McClelland.

Date of excavation:

1927.

Age and sex of individual:

A mature adult male.

Burial covering:

A large cairn of stones.

Shaft preparation:

The shaft was 3ft in depth and cut well into the shale bedrock. It was packed with stones above and around the skeleton.. The skeleton was found sitting on a stone.

Body position:

The skeleton was interred in an upright sitting position.

Associated material:

One fragment of thin pottery was found in the grave.

Sources:

Albany Museum Accession Register.

10. Burial no:

HS175/UCT116B.

Site:

Kleinpoort. (33°15'S;26°46'E).

Location:

Approximately one mile away from grave HS174/UCT131B., on the same farm Kleinpoort near Committees, Albany district.

Excavator:

Mr. L. McClelland.

Date of excavation:

January 1928.

Age and sex of individual:

A child less than 6 years of age. Sex indeterminate.

Burial covering:

A large cairn of stone.

Shaft preparation:

Not recorded.

Body position:

Not recorded.

Associated material:

Two pottery fragments, bones of a small bovid and carnivore were found in this grave. There is a rockshelter nearby which has paintings.

Sources:

Albany Museum Accession Register.

11. Burial no:

HS176/UCT189B.

Site:

Kleinpoort. (33°15'S;26°45'E).

Location:

Farm Kleinpoort near Committees, Albany district.

Excavators:

Mr. R. Pannell, Mr. W. Pannell, and Mr. McClelland.

Date of excavation:

1928.

Age and sex of individual:

A juvenile age 7 to 8 years. Sex indeterminate.

Burial covering:

A large cairn of stones.

Shaft preparation:

The shaft was found to be approximately 3ft , below ground surface, and cut well into the shale. Many stones were placed above and around the skeleton. The skeleton was found sitting on a stone.

Body position:

The body was interred in a sitting position.

Associated material:

Five hollow quern stones were found amongst the stones used in the cairn.

Sources:

Albany Museum Accession Register.

12. Burial no:

HS177/UCT122B.

Site:

Kleinpoort. (33°15'S; 26°45'E).

Location:

Grave on farm Kleinpoort, Albany district.

Excavators:

Mr. R. Pannell, Mr. W. Pannell and Mr. L. McClelland.

Date of excavation:

1928.

Age and sex of individual:

A mature adult female.

Burial covering:

A cairn of stones.

Shaft preparation:

The shaft of this grave was shallow, less than 3ft deep. It was packed with stones and extended to the shale bedrock.

Body position:

The body was interred in a sitting position resting on the shale bedrock.

Associated material:

Hollow Quern stones and unidentifiable bone of an animal were found in this grave.

Sources:

Albany Museum Accession Register.

134

Burial no:

HS178/UCT153B.

Site:

Kleinpoort. (33°15'S; 26°45'E).

Location:

Farm Kleinpoort near Committees, Albany district.

Excavators:

Mr. W. Pannell and Mr. L. McClelland.

Date of excavation:

January 1928.

Age and sex of individual:

An old adult female age 40⁺.

Burial covering:

A cairn of stones.

Shaft preparation:

Not recorded.

Body position:

Not recorded.

Associated material:

One fragment of pottery, plus fragments of unidentifiable bone.

Sources:

Albany Museum Accession Register.

14.

Burial no:

HS181/UCT104B.

Site:

Kleinpoort. (33°15'S;26°45'E).

Location:

Farm Kleinpoort near Committees, Albany district.

Excavators:

Mr. R. Pannell and Mr. W. Pannell.

Date of excavation:

18th August 1928.

Age and sex of individual:

Juvenile aged 8 to 10 years, sex indeterminate.

Burial covering:

A large cairn of stones.

Shaft preparation:

Depth of shaft was approximately 2ft. Stones
were packed on and around the skeleton.

Body position:

The body was interred in a sitting posture.

Associated material:

No associated material was recorded.

Sources:

Albany Museum Accession Register.

15.

Burial no:

HS182/UCT137B.

Site:

Lakeside. (33°15'S;25°45'E).

Location:

The farm Lakeside near to Kleinpoort near
Committees, Albany district.

Excavator.

Mr. R. Pannell.

Date of excavation:

September 1928.

Age and sex of individual:

Juvenile of the age 6 to 7 years, sex indeterminate.

Burial covering:

A cairn of stones.

Shaft preparation:

Not recorded.

Body position:

The body was interred in a sitting position.

Associated material:

No material was recorded.

Notes:

The records state that this burial is similar to the Kleinpoort burials.

Sources:

Albany Museum Accession Register.

16.

Burial no:

HS193/UCT150B.

Site:

Kleinpoort. (33°15'S; 26°45'E).

Location:

Farm Kleinpoort near Committees, Albany district.

Excavators:

Mr. S. Zuckerman, Mr. R. Pannell, Mr. W. Pannell,
and Mr. J. Hewitt.

PLATE VII

A detailed view of a skeleton (HS193/UCT150B) of a child about 3 years of age from a grave on the farm Kleinpoort. This child was excavated by the Pannell brothers, J. Hewitt and S. Zuckerman during 1930. Note the upright sitting posture of the skeleton - characteristic of the pastoralist form of body placement.



Date of excavation:

1930.

Age and sex of individual:

A child approximately 3 years of age, sex indeterminate.

Burial covering:

A stone cairn.

Shaft preparation:

The shaft was approximately 3ft deep, no other preparation was evident.

Body position:

The body was interred in the upright sitting position. (See Plate VII).

Associated material:

No associated material was recovered.

Sources:

Albany Museum Accession Register.

Burial no:

HS197/UCT127B.

Site:

Kleinpoort. (33°15'S; 26°45'E).

Location:

Farm Kleinpoort near Committees, Albany district.

Excavators:

Mr. W. Pannell and Mr. J. Hewitt.

Date of excavation:

20th July 1931.

Age and sex of individual:

Child aged 2 to 3 years, sex indeterminate.

Burial covering:

This grave was covered with long elongated stones.

Shaft preparation:

The grave shaft was shallow, the top of the skull was only 18in. below the surface.

Body position:

The body was interred in the upright sitting posture.

Associated material:

No associated grave goods were recorded.

Sources:

Albany Museum Accession Register.

18. Burial no:

HS127/UCT164B.

Site:

Kleinpoort. (33°15'S;26°45'E).

Location:

This site is situated on the flats near the boundary of the farm Kleinpoort, next to the gates on entering from the main road to Committees, Albany district.

Excavators:

Mr. R. Pannell and Mr. J. Hewitt.

Date of excavation:

1931.

Age and sex of individual:

Sub-adult male aged approximately 17 years.

Shaft preparation:

The depth of the shaft was approximately 4ft.

The skeleton was found at 2 ft.

Body position:

The position of the skeleton could not be ascertained as it was evident that the grave had been disturbed by an antbear.

Associated material:

No associated material was recovered in this grave.

Sources:

Albany Museum Accession Register.

19. Burial no:

HS207.

Site:

Kleinpoort. (33°15'S;26°45'E).

Location:

This site is situated just outside the Lappans veld boundary, on the farm Kleinpoort, Albany district.

Excavators:

Mr. W. Pannell and Mr. P. Pannell.

Date of excavation:

June 1932.

Age and sex of individual:

A mature adult male.

Burial covering:

A large stone cairn covering the grave.

PLATE VIII

A detailed view of an adult male skeleton (HS207)
excavated in 1932 on the farm Kleinpoort by the
Pannell brothers.



Shaft preparation:

This burial was shallow with the skeleton found at a depth of 26 ins.

Body position:

The body was apparently interred on its back, with legs flexed. (See plate VII).

Associated material:

No objects were found in the grave, but immediately near the grave on the surface Wilton artefacts were recovered. Near this burial there was a similar one which was excavated, but no skeleton was found. However, grindstones and pottery were found in the mound.

Sources:

Albany Museum Accession Register.

20. Burial no:

HS277.

Site:

Sea Vista. (34°11'S; 24°50'E).

Location:

The site is 500yds from the sea and a mile south of the harbour of the edge of the Sea Vista Township, Cape St. Francis, Humansdorp district.

Excavator:

Miss. P. Cairns.

Date of excavation:

1971.

Age and sex of individual:

A mature adult female.

Burial covering:

No evidence of burial covering.

Shaft preparation:

No evidence of a shaft, if there was it would have been destroyed by sand erosion.

Body position:

Semi-squatting upright. The skeleton was orientated towards the east.

Associated material:

No grave goods were found. It is probable that the skeleton originally was associated with the midden nearby, as it is only a few feet away from the present eroded edge. The fill of the burial included shell such as Donax sp., Oxysteles sp., and Perna sp. A circular stone hearth was found nearby (Cairns 1975).

Sources:

Albany Museum Accession Register.

21. Burial no:

HS278/UCT159B.

Site:

Sea Vista. (34°11'S;24°50'E).

Location:

The site is situated on an eroded slope of a sand dune, about 2.13m downslope from an insitu midden. The site is near the Sea Vista Township, Cape St. Francis, Humansdorp district.

Excavator:

Miss. P. Cairns.

Date of excavation:

December 1971.

Age and sex of individual:

An adult whose sex is undetermined.

Burial covering:

If there was any burial covering it had eroded away.

Shaft preparation:

Any evidence of a shaft had eroded away.

Body position:

The skeleton was lying on its right side, with legs slightly drawn up. One arm was up in front of the chest, while the other was stretched out. The whole body was orientated towards the north.

Associated material:

No associated material was found.

Sources:

Albany Museum Accession Register.

22. Burial no:

SAM.A.P.6032/UCT261.

Site:

Seal Point. (34°17'S;24°46'E).

Location:

The site is approximately 4.5lm north of the Seal Point light-house, in an area known as the Second Bush. The burial was situated about 150m from the shore on the inner slope of a depression between the sand dunes (Thackeray & Feast 1974).

Excavators:

Mr. F. Thackeray and Mr. E. Feast.

Date of excavation:

December 1972.

Age and sex of individual:

Full adult. Sex - possible male (De Villiers 1974).

Burial covering:

Not recorded.

Shaft preparation:

None recorded.

Body position:

The skeleton lay horizontally with arms and legs contracted; the head faced east, (Thackeray and Feast 1974).

Associated material:

Around the neck were recovered twenty-seven similarly shaped Trbo sarmaticus shell fragments. Also associated was a pendant made from a single valve of a white mussel (Donax Serra); a large hole is positioned centrally and there are three notches on the ventral surface. Near the head a grind stone was recovered.

Notes:

A bone sample from this skeleton was C14 dated to $5180^{+} 65$ years B.P. = 3230B.C. (Pta 1089).

Sources:

Thackeray & Feast (1974).

De Villiers (1974).

23. Burial no:

HS223/UCT115B.

Site:

Seal Point. (34°17'S;24°46'E).

Location:

The site is located with shell middens located inland from Seal Point, Cape St. Francis, Humansdorp district.

Excavator:

Mr. F. Cronwright.

Date of excavation:

1935.

Age and sex of individual:

A mature adult male over 30 years of age.

Burial covering:

No burial covering recorded.

Shaft preparation:

No information.

Body position:

Not recorded.

Associated material:

This burial was located under a thin layer of shell midden. Five ostrich shell beads and some worn shell pendants were found with the skeleton.

Sources:

Albany Museum Accession Register.

24. Burial no:

HS221/UCT145B.

Site:

Kleinmonde. (33°35'S;27°03'E).

Age and sex of individual:

A child approximately 6 years of age. Sex indeterminate.

Burial covering:

Nothing evident.

Body position:

The skeleton had eroded out of a shell midden.

Associated material:

No associated grave goods were recovered, but from Plate ^{IX}IX it seems that this burial was indirectly associated with a midden.

Sources:

Albany Museum Accession Register.

25. Burial no:

HS108/UCT156B.

Site:

Port Alfred. (33°36'S;25°56'E).

Location:

The Port Alfred golf course, Bathurst district.

Excavator:

Mr. M.L. Parker.

Date of excavation:

May 1918.

Age and sex of individual:

A juvenile of 6 to 10 years of age, sex indeterminate.

Burial covering:

A single large stone covered the grave.

Shaft preparation:

Not recorded.

Body position:

Not recorded.

Associated material:

Not recorded.

Sources:

Albany Museum Accession Register.

26. Burial no:

HS126/UCT139B.

Site:

Port Alfred. (33°36'S;25°56'E).

Location:

The Port Alfred golf course, Port Alfred,
Bathurst district.

Excavator:

Mr. R. Ohlsson.

Date of excavation:

1920.

Age and sex of individual:

A full adult male.

Burial covering:

A large flat stone resting on the head.

Shaft preparation:

Not recorded.

Body position:

Not recorded.

Associated material:

None recorded.

Sources:

Albany Museum Accession Register.

PLATE IX

View of the skeleton of a child of approximately 6 years of age found exposed on a shell midden at Kleinemonde (HS221/UCT145B). To the right are Mr. & Mrs. Fletcher who are looking at the sun-bleached bones.



27. Burial no:

HS246/UCT144B.

Site:

Bretton beach. (33°36'S;26°56'E).

Location:

The site is situated 400yds from the beach,
Port Alfred, Bathurst district.

Excavator:

Mr. L. Tomlinson.

Date of excavation:

28th November 1946.

Age and sex of individual:

An adult female age 20 to 25 years.

Burial covering:

A stone cairn consisting of 20 to 25 stones
piled close together and also partly buried
underground.

Shaft preparation:

The diameter of the shaft was approximately
 $2\frac{1}{2}$ ft and was packed with stones. At a
depth of $3\frac{1}{2}$ ft the skeleton was recovered.

Body position:

The sitting flexed position.

Associated material:

A few bones belonging to a spring hare were
recovered from below the skeleton.

Sources:

Albany Museum Accession Register.

28. Burial nos:

HS244a/UCT108B; HS244b/UCT109B; HS244c/UCT110B;
 HS244d/UCT111B; HS244e/UCT112B; HS244f; HS244g.

Site:

Paardefontein. (32°50'S; 25°40'E).

Location:

The site is situated on the farm Paardefontein,
 Jansenville district.

Excavator:

Mr. L. Hobson.

Date of excavation:

April 1946.

Age and sex of individuals:

<u>HS no.</u>	<u>UCT no.</u>	<u>Age.</u>	<u>Sex.</u>
244a	108B	Mature adult 30 to 40.	Female.
244b	109B	Young adult 20 to 25.	Male.
244c	110B	Sub-adult 17 to 18 yrs.	Female.
244d	111B	Child 6 to 9 years.	Indeter- minate.
244e	112B	Child 6 to 9 years.	Indeter- minate.
244f	----	Child 3 to 4 years.	Indeter- minate.
244g	----	Child 3 to 4 years.	Indeter- minate.

Burial covering:

No burial covering was observed.

Shaft preparation:

All the above individuals were found in a common
 grave about 1.5m in diameter.

Body positions:

Not recorded.

Associated material:

Nothing recorded.

Notes:

The grave situated on the banks of a small river was exposed by floods during the year 1946, or earlier. There was apparently no grave covering or associated grave goods. It is suspected that this mass burial resulted from conflict with early europeans or indigenous peoples in the area. The age of the grave is unknown, but from the excellent preservation of the bones, the possibility of european contact, it seems likely that these individuals were interred within the last 200 years. Evidence from adult crania suggests that the individuals represented have Khoisanoid affinities. From the evidence presented in the table above it is suggested that these individuals represent a family group, one adult male shows severe ossification of the right ankle joint. No other pathology was observed.

Source:

Albany Museum Accession Register.

29. Burial no:

HS265/UCT158B.

Site:

New Gloucester 'Cave 5'. (33°28'S:26°57'E).

Location:

This site is known as the 'Cave 5' site situated in the Trappes valley on the farm New Gloucester, Albany district.

Excavator:

Mr. W.C.W. Richardson.

Date of excavation:

1964.

Age and sex of individual:

A child aged about 5 years, sex indeterminate.

Burial covering:

No information.

Shaft preparation:

This grave was said to be lined with limestone.

Body position:

No information.

Associated material:

This burial was found in deposits containing a Wilton/Smithfield 'C' industry, pottery was found but no crescents.

Sources:

Albany Museum Accession Register.

30. Burial no:

HS238/UCT155B.

Site:

Widcome. (33°20'S;26°56'E).

Location:

A small cave situated on the Coombes river, farm Widcome, Albany district.

Excavators:

Mr. E.D. Mountain, Mr. E. Midley, Mr. A. Brett and Mr. J. Hewitt.

Date of excavation:

16th July 1941.

Age and sex of individual:

A juvenile aged 11 to 12 years, sex indeterminate.

Burial covering:

This burial was found at a depth of 2ft and was covered with stone slabs.

Shaft preparation:

The burial shaft was located directly under a layer of bedding, and it cut down into an ash layer. No further shaft preparation was evident.

Body position:

No information was recorded.

Associated material:

No direct associated grave goods are evident, but the records state that the ash layer contained bone and stone artefacts. No crescents were found. One or two indistinct red paintings, including hand prints were found on the wall.

Sources:

Albany Museum Accession Register.

34. Burial no:

HS236/UCT128B.

Site:

Mitford Park. (32°20'S; 26°30'E).

Location:

A small rock-shelter north-west of Grahamstown.

Excavators:

Mr. T. Hodle and Mr. J. Hewitt.

Date of excavation:

Between 1939 and 1940.

Age and sex of individual:

A child aged 6 years, sex indeterminate.

Burial covering:

The skeleton was partially exposed and not deeply buried. There was no form of grave covering.

Shaft preparation:

Owing to the shallow deposits, it is probable that the body was interred in a horizontal position either on its side or back.

Associated material:

Bored Nassa Krassiana shells, Cafferia caffer, Achatina sp., and tortoise shell fragments.

Sources:

Albany Museum Accession Register.

32. Burial nos:

HS190a/UCT098B; HS190b/UCT099B; HS190c/UCT100B.

Site:

Salem Commonage. (33°32'S;15°25'E).

Location:

Cave near Salem commonage, Bathurst district.

Excavators:

Dr. P.W. Laidler and Mr. J. Hewitt.

Date of excavation:

1929.

Age and sex of individuals:

<u>HSno.</u>	<u>UCT no.</u>	<u>Age.</u>	<u>Sex.</u>
190a	098B	Old Adult.	Indeterminate.
190b	099B	Full adult.	Indeterminate.
190c	100B	Child approx. 6 years.	Indeterminate.

Burial covering:

Each skeleton was buried beneath stone slabs.

Shaft preparation:

Nothing recorded.

Position of bodies:

Not recorded.

Associated material:

No directly associated materials are listed with these graves.

Source:

Albany Museum Accession Register.

33. Burial no:

HS204/UCT106B.

Site:

Mooikrantz cave. (33°15'S;25°37'E).

Location:

The cave is situated on the White river, farm Vugeboom in the Zuurberg, Alexandria district.

Excavators:

Mr. R.B. Rudman and Mr. J. Hewitt.

Date of excavation:

April 1932.

Age and sex of individual:

A mature adult male.

Burial covering:

Nothing recorded.

Shaft preparation:

All that is noted is that this is a shallow burial which had been disturbed by animals.

Body position:

Owing to the disturbance of the grave by animals the position of the body could not be ascertained.

Associated material:

No associated material recorded.

Source:

Albany Museum Accession Register.

34. Burial nos:

HS198/UCT105B; HS199/UCT125B; HS200/UCT126B.

Site:

Vygeboom. (33°15'S; 25°37'E).

Location:

This cave is situated in Middlekop kloof, farm Vygeboom in the Zuurberg, Alexandria district.

Excavators:

Mr. J. Hewitt, Mr. S.B. Fowlds, and Mr. R.B. Rudman.

Date of excavation:

November 1931.

Age and sex of individuals:

<u>HS no.</u>	<u>UCT no.</u>	<u>Age.</u>	<u>Sex.</u>
198	105B	Sub-adult 12 to 13 years.	Indeterminate.
199	125B	Sub-adult 16 yrs of age.	Female.
200	126B	Sub-adult 15 to 16 years.	Male.

Burial covering:

198	105B	Skeleton found under a flat stone at a depth of 3ft.
199	125B	Skeleton found under a flat stone at a depth of 3ft 6ins.
200	126B	Found under a flat stone.

Shaft preparation:

In all three cases it seems that the skeletons were located directly under the stones covering the graves. The shafts do not seem to be very deep as the cave deposits are shallow.

Position of bodies:

All these skeletons were huddled up according to Hewitt. No more details are known.

Associated material:

<u>Hs no.</u>	<u>UCT no.</u>	<u>Associated materials.</u>
198	105B	Shell of a fresh water mussel intact. Tusks of a Bushpig. Bits of tortoise carapace. Three metatarsals of a medium sized antelope. A broken rig stone. Fragments of <u>Donax</u> <u>serra</u> .

199	125B	A large pig tusk. Four buck limb bones. (one limb bone had tally markings in two series).
200	126B	A bone Bodkin. Two shell pendants. A stone ring. 200 ostrich shell beads. Foot bone of small antelope. Tortoise carapace. Tooth of a Lynx. The first two vertebra of a small carnivore.

Notes:

HS199 and HS200 were interred next to one another and their bones were mixed up. These two skeletons were buried a little below HS198 and a few feet away.

Source:

Albany Museum Accession Register.

35. Burial no:

HS205/UCT114B.

Site:

Middlekop. (33°15'S;25°37'E).

Location:

This cave is situated on Middlekop, about 5 to 10 minutes walk from the homestead of the farm Vygeboom, Alexandria district.

Excavators:

Mr. J. Hewitt and Mr. E. van Jaarsveld.

Date of excavation:

1932.

Age and sex of individual:

A child less than three years of age, sex
indeterminate.

Burial covering:

Not recorded.

Shaft preparation:

No record.

Body position:

No record.

Associated material:

No record.

Source:

Albany Museum Accession Register.

36. Burial nos:

HS195a/UCT147B; HS195b; HS195c; UCT262; UCT263.

Site:

Melkhoutboom. (33°19'S; 25°17'E).

Location:

This cave is located on the northern extremities
of the Zuurberg range, in a sheltered valley
which drains into the Beans river, Alexandria
district.

Excavators:

Mr. J. Hewitt* and Dr. H.J. Deacon.**

Date of excavation:

The first excavation was held in 1930* and the
second in 1969.**

Age and sex of individuals:

	<u>HS no.</u>	<u>UCT no.</u>	<u>Age.</u>	<u>Sex.</u>
*	195a	147B	Adult 20 to 25 years.	Indeterminate.
*	195b	----	Infant.	Indeterminate.
*	195c	----	Infant.	Indeterminate.
**	----	263B	Child about 5 years.	Indeterminate.
**	----	262B	Infant.	Indeterminate.

Burial covering:

HS195a to c, were covered by flat stones, at the back of the cave. These flat burial stones were situated about 18 to 20 ins. below the dry layers of bedding (Hewitt 1931a:547). The infant burial (UCT262) was found at the edge of Hewitt's (ii), cutting. This burial had a large flat quartzite boulder as grave covering. The child burial (UCT263.), had an extensive ochre capped grave shaft and 3 large stones, two of which were grind-stones, overlying the skeleton (Deacon 1976:35).

Shaft preparation:

The three burials excavated by Hewitt, were all very much disturbed, and no information in this category could be obtained. Deacon was able to record information on both the 1969 burials. The infant burial truncated part of a tapering pit, that had at it's base a vertical sided grave shaft approximately 300mm. in depth. The child burial was interred in a deep vertical sided grave shaft which began from the top of the main bedding unit and extended to the top on the Marker unit.

Three large stones had been placed in the shaft, (Deacon 1976:35-36).

Body position:

All the 1931 burials were disturbed, therefore body position could not be ascertained. No information on the 1969 infant burial is recorded. The child burial was found to be interred in a squatting position with the hand on the knees.

Associated material:

The only burial with recorded associated material is the child burial. Grave goods included three notched sea shells, 14 beads made from gritty earth which had apparently been baked.

Notes:

The 1969 infant burial has an associated date of 7300 B.P. (UW234), which refers to the Wilton Base Marker unit. The 1969 child burial is associated with the top of the Main Bedding unit and date from approximately 3000 B.P. (Deacon 1976). The 1931 burials were located 18 to 20 ins. below a layer of drier bedding, in the pre-pottery Wilton levels. Deacon (1969), has provenanced these burials to the Wilton levels. These burials have been assigned to the 'Matjies River Race' and their similarities with the Wilton skull (HS119/UCT146B9., and those excavated at Salem (HS190a/UCT=98B; HS190b/UCT099B; HS190c/UCT100B), are mentioned (Hewitt 1931a).

Sources:

Albany Museum Accession Register.

Hewitt (1931a).

H.J. Deacon (1969;1976).

37. Burial nos:

HS150a;HS150b;HS150c/UCT118B;HS160a/UCT120B;

HS160b;HS161a/UCT117B;HS161b;HS159.

Site:

Kabeljaaus River cave A. (34°00'S;24°55'E).

Location:

A large rock shelter in the valley of the Kabeljaaus river, about 3 miles from the sea, near Jeffreys Bay, Humansdorp district.

Excavator:

Mr. J. Hewitt.

Date of excavation:

January 1925.

Age and sex of individuals:

<u>HS no.</u>	<u>UCT no.</u>	<u>Age.</u>	<u>Sex.</u>
150a	----	Infant 1 to 2 yrs.	Indeterminate.
150b	----	Infant less than 1 year.	Indeterminate.
150c	118B	Old adult 40+	Male.
160a	120B	Juvenile 5+	Indeterminate.
160b	----	Juvenile 5+	Indeterminate.
161b	----	Juvenile 5+	Indeterminate.
159	----	Old Adult	Indeterminate.

Burial covering:

Most of the above burials seem to have been located at the back of the cave, under the rear protruding wall. One burial HS150., occurred

near the middle of the cave. No form of burial covering has been recorded.

Shaft preparation:

Owing to the shallow nature of the deposits (approximately 5ft) it would be expected that the grave would be shallow depressions rather than deep shafts.

Body positions:

Not recorded.

Associated material:

Burial HS150c., had ostrich shell beads associated. Another had delicate shell beads, but the exact burial to which these beads belong is not known. Hewitt (1925), describes the bulk of the cultural material collected at this cave, but it is not clear whether the materials such as; bored stones, Palletts, pendants and rubbing stones stained with red ochre were associated grave goods or these objects formed part of the general excavation.

Notes:

Hewitt (1925), states that the skull characteristics of HS150c., an old adult, compare well with the specimens from Spitzkop cave. Furthermore, he argues that this skeleton is recent owing to the good state of preservation of the bones, and dates this specimen subsequent to the Late Stone age period. Two other skulls one adult, the other a child fall into the same category.

Sources:

Hewitt (1925).

38. Burial no:

HS15a/UCT121B;HS151b;HS152;HS153.

Site:

Kabeljauws River Cave B. (34°00'S;24°55'E).

Location:

A small rock shelter adjoining Kabeljauws River A, situated in the Kabeljauws river valley, near Jeffreys Bay, Humansdorp district.

Excavator:

Mr. J. Hewitt.

Date of excavation:

January 1925.

Age and sex of individuals:

<u>HS no.</u>	<u>UCT no.</u>	<u>Age.</u>	<u>Sex.</u>
151a	121B	Sub-adult 17 to 21 years.	Female.
151b	----	Sub-adult 12 years.	Indeterminate.
152	----	Sub-adult 14 to 15 years.	Indeterminate.
153	----	Infant.	Indeterminate.

Burial covering:

It appears that these skeletons were dug out of the rear of the cave. No burial covering was recorded.

Shaft preparation:

Not recorded.

Body positions:

Not recorded.

Associated material:

Hewitt (1925) in his description of the material from the Kabeljauws river caves does not

distinguish between the above cave and Kabeljaaus river cave A., in terms of the cultural material. All that is mentioned is that the deposits of the caves are similar. Fortunately Hewitt does make a distinction between these caves in the burial register. However, all that is known about associated material in this cave is that the infant burial showed extensive ochre stains on the cranium.

Sources:

Hewitt (1925).

39. Burial no:

HS119/UCT146B; HS116/UCT171B; HS122/UCT169B;
HS124/UCT154B.

Site:

Wilton Large Rock Shelter. (33°22'S; 26°18'E).

Location:

The site is situated on the farm Wilton, near Alicedale, Albany district.

Excavators:

Mr. J. Hewitt, Rev. P. Stapleton, and Rev. W. Kilroe.

Date of excavation:

August 1921.

Age and sex of individuals:

<u>HS no.</u>	<u>UCT no.</u>	<u>Age.</u>	<u>Sex.</u>
119	146B	Sub-adult 17 years.	Female.
116	171B	Child 6 years.	Indeterminate.
122	169B	Child 6 years.	Indeterminate.
124	154B	Mature adult.	Female.

Burial covering:

All skeletons recovered from this shelter were buried under flat slabs of stone which had been painted with red ochre on the underside.

Shaft preparation:

No specific information recorded. The only statement that can be made on this category is that these graves are shallow.

Body positions:

Hewitt (1921) notes that the skeletons were all very much huddled up.

Associated material:

Besides the presence of ochre on the slabs of stone covering the graves, the child burial (HS116), had a rubbing stone associated. Hewitt also mentions that numerous ostrich shell beads were taken from the above burials.

Notes:

In his description of the cave, Hewitt considered the human skeletal material to belong to a group of 'Short-headed' bushmen who made delicate ostrich shell beads, pygmy crescents and the tiny scrapers. These people were also the authors of the superior rock-paintings found in the cave (Hewitt 1921:459). Deacon (1969), was able to obtain a C14 date on sub-adult skeleton from this cave, which gave a date of $8260^{+} 720$ years B.P. (6310B.C.). (Gak-1541). This skeleton it is suggested dates from the base of layer 3, but it was found to be impossible to pinpoint its position

PLATE X

View of Wilton Large Rock-shelter showing the extent of Hewitt's early excavations. Four skeletons were removed from this site by early excavators. To the left is the Rev. Stapleton.



more accurately. The other skeletons in the cave could not be assigned to any level of the 1969 excavations. (Plate X)

Sources:

Hewitt (1921).

J. Deacon (1969).

40. Burial nos:

HS120/UCT168B; HS121/UCT135B; HS123; HS125.

Site:

Wilton Cave. (33°22'S; 26°18'E).

Location:

This cave is situated on the Hoffmans river, farm Wilton near Alicedale, Albany district.

Excavator:

Mr. J. Hewitt.

Date of excavation:

1921.

Age and sex of individuals:

	<u>HS no.</u>	<u>UCT no.</u>	<u>Age.</u>	<u>Sex.</u>
	120	168B	Sub-adult 12 to 16 years.	Male.
	121	135B	Child 5 to 6 years.	Indeterminate.
*	123	----	Adult.	Indeterminate.
*	125	----	Infant.	Indeterminate.
*	These skeletons are not present in the Albany Museum.			

Burial covering:

These burials were covered by stones painted with red ochre on the underside.

Shaft preparation:

The graves were all shallow depressions.

Body positions:

Skeletons HS120 and HS121, were found adjacent to one another in the same hole. HS121 had been buried on the right side and was huddled up. The other skeletons were found in similar positions.

Associated material:

HS120/UCT168B: Two crescents and two bevelled knives were found near this burial.

HS121/UCT135B: No associated material recorded.

HS123 : Ostrich shell beads, a bodkin and two rubbing stones were found in this grave.

HS125 : No associated material recorded.

Notes:

Hewitt (1921) considered these skeletons to belong to a group of 'prognathous' bushmen, probably Damasonqua or Gonaqua herders, who were the manufacturers of end scrapers, lance and arrow heads, neolithic implements, pottery and bone and ivory artefacts. These peoples also wore bone beads in place of ostrich shell beads, made ornaments from marine shell and lived in caves, on the banks of the Fish river near Cradock and the coast. (Plate XI)

Sources:

Hewitt (1921).

PLATE XI

View of Wilton Cave, from which four skeletons were excavated. The four persons to the left are members of the Wilmot family, and the second from the right is the Rev. Stapleton.



41. Burial nos:

HS128a/UCT174B; HS128b/UCT175B; HS128c/UCT176B;
 HS128d/UCT173B; HS128e/UCT208B; 128f/UCT177B;
 HS128g/UCT178B; HS128h/UCT209B; HS131/UCT179B;
 HS132/UCT181B; HS135/UCT182B; HS136/UCT183B;
 HS137; HS138/UCT185B; HS139/UCT186B; HS133/UCT181B.

Site:

Spitzkop cave. (33°20'S; 26°13'E).

Location:

A small cave on the farm Spitzkop near Springvale
 siding, Albany district.

Excavator:

Mr. W. Austin.

Date of excavation:

December 1921.

Age and sex of individuals:

<u>HS no.</u>	<u>UCT no.</u>	<u>Age.</u>	<u>Sex.</u>
128a	174B	Infant.	Indeterminate.
128b	175B	Infant.	Indeterminate.
128c	176B	Infant.	Indeterminate.
128d	173B	Infant.	Indeterminate.
128e	208B	Sub-adult 17 to 21 yrs.	Indeterminate.
128f	177B	Mature adult.	Indeterminate.
128g	178B	Mature adult.	Indeterminate.
128h	209B	Mature adult.	Indeterminate.
131	179B	Mature adult.	Male.
132	180B	Juvenile 9 to 10.	Indeterminate.
133	181B	Juvenile 9 to 10.	Indeterminate.
135	182B	Child 1 to 2.	Indeterminate.

136	183B	Old adult.	Female.
137	----	Child 3 to 4.	Indeterminate.
138	185B	Child 2 to 3.	Indeterminate.
139	186B	Young adult 18+.	Indeterminate.

Minimum numbers were taken on right humeri, of which 16 individuals were found to be represented.

Humeri shafts were sampled for ^{13}C analysis.

Burial covering:

Hewitt (1921:461), mentions that a funeral slab was recovered in the bottom layers of Spitzkop overlying a skeleton. This slab had indistinct paintings which resemble fat tailed sheep.

Slabs or Rocks covering most of these graves.

Shaft preparation:

No shaft preparation evident.

Body positions:

Side flexed or just flexed.

Associated material:

These skeletons were found in association with various items none of which are assigned directly to any particular skeleton.

Notes:

The following portion of a letter dated the 20th December 1921, from Mr. W.W. Austin to Mr. Hewitt provides additional information regarding the Spitzkop burials:-

'The skeletons were found at various depths in the ash - one of a child near the surface under about 18in of ash, this was completely decayed. Some in the bottom of cave under about 8ft of ash, were also decayed and of no value - several (at different depths), had pieces of ant heap

packed over and around them. All had flat slabs of rock over them with the exception of one, this had only the ant heap over it (under four feet of ash). They were not in a sitting position, but placed so as to take as little room as possible. The rocks placed over pressed them down some forward face down, others backwards. All were in a very cramped and folded up sort of position. The bones were broken the rocks were pressing on them. The skull with the small hole in the forehead had no stones on the skull - must have been broken before burial. The beads on strings were mostly found with the skeletons presumably of females, anyhow they were not found with the largest skeletons. The roughly made incomplete ostrich shell beads were not found with skeletons but scattered about in the ash at various depths.'

Sources:

Albany Museum Accession Register.

Hewitt (1921).

Deacon (1969).